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ELECTRIC SLEEP (A CLINICAL-PHYSIOLOGICAL INVESTIGATION)
[A translation]

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ELECTRIC SLEEP (A CLINICAL-PHYSIOLOGICAL INVESTIGATION)
[A translation]

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Foreword to the Second Edition

The first edition of our monograph, "Elektroson" [Electric Sleep] was published five years ago. In this monograph the results of the work of our group were presented in the field of study of the nature of electric sleep and the distinction of it from electronarcosis, the changes produced in the organism by electric sleep were described, and the possibilities were also mentioned of utilizing it for therapeutic purposes.

We believe that a characteristic feature of electric sleep is the direct effect of the low frequency pulsating small current, but, at the same time, we do not deny the significance of stimulation of the peripheral nervous system by the current. This has been shown by experiments on animals where the pulsating low frequency current acted through electrodes implanted in the skull, that is, missing the peripheral receptors. Under these conditions also, as after the effect of the pulsating current through electrodes applied to the skin, sleep occurred in the animals. Psychotherapeutic influences with the use of this method on patients had not been excluded. Therefore, further investigations confirmed the correctness of our original hypotheses.

In recent years, workers of various institutions in the Soviet Union published a number of works devoted to electric sleep, which shows its extensive distribution. We are conducting a correspondence with many scientists from foreign countries. The first publication of the monograph "Elektroson" has been translated into German (in the German Democratic Republic) and into Japanese.

In the time which has elapsed after the publication of the first edition of the monograph we have established a series of new data both in the field of investigation of the physiological nature of electric sleep and the possible discovery of the mechanism of action of the pulsating current and in the field of utilization of this method in various diseases. At the present time, electric sleep is being used successfully not only in the neuropsychiatric clinic but also in the treatment of patients with hypertensive disease, certain forms of peptic ulcer, in early toxemias of pregnancy, etc.

All this has served as the grounds for summarizing all the data existing in the field of the study of electric sleep

in the second edition of the book.

In the present monograph we have utilized the observations of I. S. Robiner, A. N. Korganova and G. V. Sergeyev, who have kindly offered us their material, for which we are expressing our appreciation.

Foreword to the First Edition

In this work the results are being reported of research in the field of treatment of patients with mental diseases which was carried out beginning with 1947 by a group in the Institute of Psychiatry of the Ministry of Health USSR (former Institute of Academy of Medical Sciences USSR).

Sleep treatment, which has a theoretical basis in the principle of protective inhibition of I. P. Pavlov, is being used progressively more extensively. At the same time, it is being made clear that amytal and other anesthetic agents used at the present time are toxic to a certain degree, which sometimes leads to complications. Naturally, it would be important to work out a method of sleep treatment whereby no drugs would have to be injected into the body. The attention of authors has been directed to the possibility of utilization of the electric current for producing sleep. In the field of study of the effect of the electric current on the nervous system Soviet workers have done considerable work. It is enough to recall the variations in electrical potentials in the central nervous system established by I. M. Sechenov with his very imperfect apparatus of that time. In addition, I. M. Sechenov was the first to carry out inhibition of spinal reflexes of the frog through the effect of an incubation [induction?] current on the thalamus.

Since research on the so-called "electronarcosis", which may be obtained through the effect of comparatively strong currents with various characteristics on the brain, has been known now for a long time we began our research with the study of electronarcosis, investigating the influence of the electric current with various characteristics on the course of mental diseases. In the work it was shown why authors afterwards rejected this method, and the entire attention was directed to the condition which is called electric sleep. In using it the authors have obtained encouraging results. However, they do not consider their research entirely complete and are publishing the results of it with the aim of attracting attention to the method. The method of producing a condition of sleep needs further development. An intensified clinical study of the influence of electric sleep on the course of various diseases is particularly necessary. This will aid in completely determining its effectiveness, areas of application, and the possibility of combination with other therapeutic measures. The investigation of the authors

was not only done in the group but was also comprehensive in the full sense of the word. In the given case, an exact clarification of the nature of the condition designated as electric sleep is of great importance. Its similarity to and its difference from physiologic, hypnotic and pharmacologic sleep were very important to establish. In the light of these changes the authors also studied the changes in the clinical picture.

M. N. Livanov and T. A. Korol'kova (electrophysiological laboratory), D. A. Biryukov and Yu. Ye. Segal' (laboratory of higher nervous activity) participated in the work.

N. M. Liventsev played an exceptionally important part in the theoretical development and creation of the appropriate apparatus. The clinic study was conducted by Z. A. Kirillova, Z. A. Ven'yeri, T. P. Simson, A. N. Korganova and M. V. Korkina. V. A. Gilyarovskiy was in charge of the work.

The apparatus was worked out in conjunction with the physico-technical department (head--A. N. Obrosof) of the State Institute of Physiotherapy.

FIRST PART
METHODS AND PHYSIOLOGICAL DATA

CHAPTER I

Current State of the Problem of Electronarcosis and Electric Sleep (review of the literature)

Eminent Russian physiologists of the nineteenth century, A. M. Filomafitskiy (1836), I. M. Sechenov (1862) and his students, B. F. Verigo (1883) and N. Ye. Vvedenskiy (1894), occupied themselves in the study of the phenomena which occur during the action of an electric current on the central or peripheral nervous system.

Indubitable priority goes to these scientists in the establishment of the general physiological rules and regulations which underly electronarcosis. Specifically, the teaching concerning parabiosis worked out by N. Ye. Vvedenskiy was of great importance for the theoretical analysis and proper direction of scientific thought of later investigators of this problem.

N. Ye. Vvedenskiy formulated his theory of parabiosis in 1901. He named the special condition of an excitable tissue which is produced by the effect of physical stimuli which are unusual for it and which represents a distinct state of excitation, persistent, not fluctuating, and therefore localized at the site of its occurrence, parabiosis. In its manifestations parabiosis has the nature of inhibition. N. Ye. Vvedenskiy considered parabiosis a general form of the reaction of the excitable tissue to various stimuli. The position of parabiosis was determined by N. Ye. Vvedenskiy among the other conditions of the nervous tissue according to the schema: "Rest--activity--parabiosis--death". Therefore, parabiosis is the last reversible stage in the condition of nervous tissue when it is acted on by strong or unusual stimuli. N. Ye. Vvedenskiy based his teaching of parabiosis on observations of the neuro-muscular apparatus; afterwards, he extended it to the central nervous system.

Thereby N. Ye. Vvedenskiy expanded his concept of parabolic inhibition, including in it also a number of inhibitory processes which occur in the body under the influence of natural impulses; N. Ye. Vvedenskiy called this inhibition "functional parabiosis".

The study of electronarcosis proper, particularly on warm-

blooded animals, was begun chiefly after 1902, at which time S. Leduc published the results of his experiments on electronarcosis of dogs and reported the first attempt at producing electronarcosis in man, which he performed on himself. However, after making a considerable number of interesting experiments, S. Leduc did not discover the characteristics of the physiological nature of electronarcosis. He considered the condition of electronarcosis to be similar to sleep, explained the mechanism of its occurrence by a special "cerebral depression," and he predicted its perspectives of replacing pharmacologic narcosis (for anesthesia in surgical operations). This directed a number of foreign scientists (particularly French) along the wrong route; without any further investigation of the problem of the nature of the condition produced they attempted to utilize electronarcosis in surgical operations.

The first investigator who occupied himself specially with the study of the problem of the physiological nature of electronarcosis, V. Yu. Chagovets (1906), correctly analyzed the question of the mechanism of action of the current, being guided by N. Ye. Vvedenskiy's theory of parabiosis. Thereby, he came to the conclusion that the mechanism of electronarcosis has nothing in common with sleep, as was asserted by S. Leduc, and that the stimulatory effect of the current, which with enough strength produces parabiosis of the brain underlies it. On the basis of his observations, V. Yu. Chagovets came to the conclusion that parabiogenic inhibition of the central nervous system, which produces a depression of sensitivity and of the voluntary movement, underlies electronarcosis.

I. A. Golyanitskiy (1912) came to similar conclusions; he conducted an extensive investigation on the electronarcosis of various animals as well as an observation on electronarcosis in man. By comparing electronarcosis with narcosis produced by pharmacologic agents, I. A. Golyanitskiy came to the conclusion that electronarcosis cannot be identified with pharmacologic narcosis.

The phenomena which were observed in electronarcosis, particularly the loss of movement and the absence of the reaction to pain, are associated with the effect of strong electrical stimuli on the central nervous system. The explanation of these phenomena by inhibition which occurs in the presence of a stimulus of considerable strength, that is, parabiosis, is a better one.

Many foreign research workers also worked on the problems of electronarcosis of animals; however, the majority of their investigations were of an experimental nature, without any physiological analysis of the nature of electric sleep. As a result, individual authors came to diverse and even contradictory conclusions. Thus, for example, some believed that electronarcosis is identical with the state of sleep or similar to it; others, on the other hand, considered it a condition of stupor and of convulsive excitation. Here, we may mention the works of A. Zimmermann and J. Dimier (1903), L. Robinovitch (1906), G. Leclerc (1910), A. Nagelschmidt (1912), Yu. Zimmermann (1929), A. Ivy and F. Barry (1932), H. Koch and G. Sack (1933), N. Samsonow (1933), F. Scheminzky (1929-1938) and others.

Later, investigations appeared in literature which dealt with a more systematic and complete study of electronarcosis of animals as well as of man (G. S. Kalendarov, L. L. Vasil'yev, V. A. Glazov, D. A. Lapitskiy and F. P. Petrov, 1937; I. I. Yakovlev and V. A. Petrov, 1938; V. A. Glazov, 1940; K. Neergard, 1923; A. Harreveld, 1933-1940). As a result of the study of electronarcosis in man experimentally it was used as a therapeutic measure in patients with mental diseases.

V. A. Glazov (1947) utilized an interrupted galvanic current with a frequency of 100 impulses per second and with a 1:10 relationship of the duration of the impulse to the duration of the pause, chiefly with fronto-lumbar arrangements of the electrodes, for the purpose of obtaining electronarcosis.

V. A. Glazov called the complex of conditions produced by the effect of a current with the characteristics mentioned and of gradually increasing strength on the central nervous system "electrical catatonia," distinguishing therein six successive phases: 1) hypnotic, 2) disinhibitory, 3) cataleptic, 4) electronarcosis, 5) decerebrate rigidity, and 6) epileptic.

In clinical practice V. A. Glazov used a current strength which was somewhat less than the current strength which produced the cataleptic phase (according to his classification). The condition of the patients was characterized by general inhibition, difficulty in speech, "poverty of ideas," etc. Sometimes, on the other hand, a "catatonic syndrome" was produced (negativism, stereotypy, catalepsy).

According to the observations of the author, this kind of influence gave a good effect on the treatment of patients with reactive psychoses and neuroses, as well as in the depressive phase of manic-depressive psychosis. As a result of this effect, a loss of inhibition, an emotional lift, and improvement in the general condition were observed in the patients.

D. V. Afanas'yev (1951) used electronarcosis in the treatment of mental patients and indicated that after the effect of a pulsating current of different strengths (fronto-lumbar arrangement of the electrodes) it was possible to observe several successive stages or phases: 1) excitation, 2) general rigidity or catalepsy with complete consciousness and general analgesia, 3) sleepiness or drowsy states, 4) a sleepy condition with extinction of the reflexes (tendon, cutaneous, and corneal). In part of the patients during electronarcosis he also noted the presence of unpleasant sensations, which disappeared when the current was turned off.

G. S. Kalendarov and Ye. I. Lebedinskaya (1952-1953) published further results of their work in the field of electronarcosis.

The authors consider that the best characteristics of the pulsating current for electronarcosis are a frequency of 100 cycles a second (with the possibility of regulation of it within limits of 75-175 cycles per second) with the duration of the impulse of one meter/second (at a frequency of 100 cycles per second).

At first, they used chiefly the fronto-lumbar arrangement of the electrodes; later, an ocular-occipital arrangement.

On the basis of his investigations G. S. Kalendarov found the existence of five successive stages of electronarcosis produced by the use of a current of different strengths: 1) electrohypnotic, 2) electrocatatonic, 3) the stage of electric sleep, 4) electrocomatose and 5) electroterminal. The authors characterized the stage of electric sleep as a condition produced by the effect of a current of moderate strength or of moderate duration, recommending that this stage be used for therapeutic purposes.

Dealing with the problem of the physiological nature of electronarcosis it should be noted that even the first Rus-

sian investigators (V. Yu. Chagovets and I. A. Golyanitskiy) explained the nature of the phenomena which they observed thereby from the point of view of N. Ye. Vvedenskiy on parabiosis. This principle was later developed in the works of G. S. Kalendarov, L. L. Vasil'yev and others during the period 1930-1939. The principle of the unity of the nature of general electronarcosis on the one hand and local cathodal parabiosis on the other was developed by L. L. Vasil'yev, for example, in the article "Electronarcosis and the Theory of It in the Light of the Teaching of N. Ye. Vvedenskiy on Parabiosis" (1952).

In his dissertation V. A. Glazov indicates that the electric current exerts a complex effect on the central nervous system, which is composed of the direct stimulation of neural structures of the base of the brain to which are added reflex influences and vascular changes, particularly in the area of the cerebral cortex.

He ascribed definite importance in the mechanism of electrical catatonia also to the effect of the electric current on the centers of the sympathetic nervous system.

V. A. Glazov connected the pathophysiological nature of various phases of electrical catatonia with the effect of the current on definite centers in the subcortical-brain stem area of the brain (thalamus, tuber cinereum, red nuclei, etc.) in the depression of the cortex as the result of vascular spasm. He conceded the extension of loops of current to the cerebral cortex only when there was considerable strength of current used (epileptic phase).

G. S. Kalendarov defines the pathophysiological mechanism of the successive stages of electronarcosis as follows: "we understand electrical narcosis to be the development of ultraboundary inhibition as a parabiologic process which develops successively (in stages) from the cortex to the spinal cord under the influence of an electric current, and which proceeds in the form of a process of successively shifting phasic changes -- transitional stages between waking and sleep, sleep and death".

The method of influencing the brain by an alternating sinusoidal current of considerable strength which has been worked out abroad also needs to be categorized in the field of electronarcosis (P. Ross and R. Allen, 1943; J. Thompson, 1944; E. Tietz and others, 1946; A. Patterson and W. Milligan,

1947; B. Pacella, 1948; K. Bowman and A. Simon, 1948; L. Alexander, 1950 and others). After appropriate study on animals the new method was used in patients with mental diseases, chiefly schizophrenia.

The method of working with the current consists in this, that first a current of 150-125 ma is used (arrangement of the electrodes is bitemporal) for 30 seconds, and then it is reduced to the threshold for respiratory recovery (60-70 ma), maintaining it constant or gradually increasing it somewhat.

Through the use of a current of considerable strength a condition is produced which is equivalent to the tonic phase of a convulsive seizure. When the strength of the current is decreased slow clonic convulsions (5 to 15 seconds) occur, and then relaxation of the muscle tone occurs and a condition of electronarcosis proper with complete immobility, hypotonia of the muscles and loss of all types of sensation of consciousness. Such a condition, however, can be maintained for no more than five to eight minutes; then, individual movements appear which can become a general motor excitation. For the purpose of preventing this the current is turned off. Therefore, the duration of the effect is limited to five to seven minutes.

By calling this method electronarcosis certain authors themselves indicate the similarity of the clinical picture of this condition to an electroconvulsive seizure. They consider the advantage of this method to be the greater duration of the period during which consciousness is lost, the less intense convulsive phenomena and the possibility of controlling the strength of the current throughout the course of the effect. The clinical effect of the new method of electronarcosis was evaluated differently. Certain authors present data as to favorable results of treatment, particularly of patients with schizophrenia; others refer to the results of treatment in a more reserved manner.

M. Ya. Sereyskiy and G. A. Totshteyn (1947), comparing the results of treatment by this method with the results of treatment by electric shock, have come to the conclusion that the present method of electronarcosis is essentially no different from electroconvulsive therapy and has no particular advantages.

N. M. Liventsev (1947-1952) carried out an extensive in-

vestigation of the effect of a pulsating current on the central nervous system of animals and man. In the experimental portion of the investigation he studied the condition of the animal (dog) produced through the effect of a pulsating current of different strengths on the central nervous system (from a minimal current producing hardly noticeable changes in the condition of the animal to the maximum possible current experimentally). Generalization of the observations made it possible to distinguish the following five phases which occur sequentially through the gradual increase in the strength of the current: 1) initial, 2) motor excitation and defensive reactions, 3) electronarcosis (usual routines), 4) electroconvulsive seizure, and 5) electric coma.

On the basis of this investigation he proposed a working hypothesis concerning the pathophysiological nature of various phases combined into this classification, at the basis of which lies I. P. Pavlov's teaching of ultraboundary inhibition produced in the central nervous system by the effect of external stimulation.

In lectures concerning the work of the cerebrum I. P. Pavlov spoke of three types of external stimulation "producing a directly inhibitory condition of the cerebral cortex; very weak, very strong and unusual". This occurs through stimulation of the nerve cell by any agents even if "they do not have any special physiological conditioning significance". Depending on the different degree of distribution and depth of inhibition as well as on the presence of foci of excitation in various centers of the central nervous system various pictures of the condition are produced.

In the case of minimum strengths of the pulsating current it acts as a weak, monotonous rythmical stimulus the prolonged effect of which can produce a gradual irradiation of inhibition throughout the cerebral cortex, corresponding to which signs are noted in the condition of the animal which make it possible to classify them as transitional phases between the waking state and sleep.

The phase of motor excitation and defensive reactions which occurs from the effect of a current of somewhat greater strength is associated chiefly with a stimulatory effect of the current on the peripheral centers of the analyzers (it is completely absent, for example, when the current acts experimentally through electrodes implanted in the brain).

In the phase of the usual routine of electronarcosis which occurs with greater current strengths a diffuse inhibition of the cerebral cortex may be supposed which occurs reflexly and according to the law of negative induction from the subcortical-brain-stem centers subjected to the more intense stimulatory effect of the current. In connection with the presence of diffuse inhibition of the cerebral cortex a general immobilization occurs, and no reactions are noted to external stimuli. Changes in muscle tone, the appearance of elements of convulsive phenomena and hyperkinesias, change in the character of respiration, and a certain increase in the arterial pressure, etc. attest to the increase in the tone of the subcortical-brain-stem centers.

When the current strength is further increased considerably the deeper phases of electronarcosis are produced: extensor rigidity, electroconvulsive seizures and electrical coma (electronarcosis from supramaximal current strengths). The physiological nature of these conditions is presumably associated with the more intense ultraboundary inhibition of the cerebral cortex which also extends to the area of the subcortical-brain-stem centers, for example, the apparatus for regulating respiration. The other centers of the subcortical-brain-stem area of the brain can thereby be found in a condition of considerable excitation (for example, the apparatus regulating the muscle tone and the position reflexes in the case of extensor rigidity, the apparatus regulating the activity of the cardio-vascular system, etc.).

In parallel with the study experimentally in animals of the reactions to the effect of considerable current strengths "experimental-clinical" observations were made of the action of a pulsating current of moderate strength, that is, within the limits of the third phase -- electronarcosis. The problem of these observations was, first, to establish the characteristics of it in man, and, secondly, to clarify the possibility and expediency of utilizing it in the capacity of a method of protective therapy.

The observations were made on 21 patients with schizophrenia chiefly of the catatonic and hallucinatory-paranoid forms. It was established that in the catatonic form of schizophrenia electronarcosis produces a disinhibition in certain patients and takes them out of their catatonic condition. The mechanism of the disinhibitory effect of electronarcosis is supposedly associated with the deepening of protective inhibition of the nerve cells under the influence

of the pulsating current, which, according to the teaching of I. P. Pavlov, underlies the catatonic condition, with a subsequent recovery of the functional capacities of the affected nerve cells. In certain patients with hallucinatory-paranoid forms the electronarcosis produced an alleviation of the pathological symptomatology.

The occurrence of unpleasant and painful sensations in many patients in the process of electronarcosis, however, as well as a restless reaction to the effect of the current limits the possibilities of utilizing this method even in patients with mental diseases.

According to the observations indicated above, the condition produced from the effect of an electric current of moderate strength on the central nervous system is considerably different from physiological sleep and, as a rule, does not change into it. True, when there is a calm reaction to the effect of the current the external picture of the condition both in animals and in man, particularly in patients with mental diseases in whom there are already elements of protective inhibition, superficially resembles physiological sleep. However, this is not a general principle. In the majority of persons, particularly in those who are mentally healthy, the effect of a current of moderate strength is accompanied by unpleasant sensations which prevent the advent of sleep, which has also been noted by V. A. Glazov and D. V. Afanas'yev.

In connection with this, V. A. Gilyarovskiy expressed the opinion that the only method of application of a pulsating current to the central nervous system of man which is acceptable can be considered the method of working with minimum current strengths which do not produce either unpleasant sensations or convulsive phenomena; nor signs of motor excitation nor considerable vegetative changes.

V. A. Gilyarovskiy also expressed the idea that the effect of a pulsating current of appropriate frequency, even with a very weak current strength, may prove to be effective in producing electrical sleep or a condition similar to it. This was the basis and the premise for the development of the method called electric sleep.

Therefore, we believe, that an essential premise for producing sleep by means of an electrical current which most closely approximates the physiological is the complete absence

of any kind of sensations disturbing the patient. Here, the only possible dosage for the current strength is the threshold at which such sensations appear. The method which we have worked out is also based on this principle.

Arbitrarily, we call electric sleep or a condition similar to it the drowsiness which is produced after the prolonged effect (sometimes only during subsequent procedures rather than during the first) of a current which in its strength does not exceed the threshold at which troublesome sensations occur, that is, a current which in its strength corresponds to the initial phase according to N. M. Liventsev's classification presented above.

Herein lies the difference in the methods of operation with and handling of the concepts of "electronarcosis" and "electric sleep" in our investigation from those in the works of other authors.

It seems to us to be more expedient to distinguish these concepts as follows: we define "electronarcosis" as an obligatory condition produced when the current is turned on and which disappears when it is turned off, and "electric sleep" as a condition of sleep or transitional states close to it which occur gradually under the influence of an electric current as a weak rhythmical stimulus, and which do not stop when the current is turned off.

We should like to note that the production of sleep under the influence of an electrical stimulation of certain brain centers rather than electronarcosis was accomplished for the first time experimentally by Hess (1929) and then by O. A. Mikhaleva, Ye. A. Moiseyev and A. V. Tonkikh (1939). In these experiments the drowsy condition and sleep were produced by means of stimulation of definite portions of the hypothalamic area with an electric current. The experiments were performed on cats by means of the introduction (through trephined openings in the skull) of special needle-electrodes into appropriate sections of the brain, which needles were insulated throughout (except at the ends), and through which the current was passed.

When the current acted for $1\frac{1}{2}$ to 2 minutes different conditions were noted in the cats -- from drowsiness to deep sleep -- which lasted from 20 minutes to one hour. The localization of the electrodes was afterwards established at autopsy.

A. M. Zimkina (1946), utilizing a similar method, produced a superficial sleep or drowsy condition in cats by stimulation of the cerebellum with the electric current.

Hess explained the occurrence of sleep in these experiments by the stimulation of the so-called "sleep center" by the electric current.

Other authors have associated these phenomena with stimulation of the vegetative nerve centers by the current, as a result of which a diffuse inhibition occurred in the brain.

I. P. Pavlov in his report "The Sleep Problem" mentions the experiments of Hess. Here, in criticizing the theory of "sleep centers" he mentions that, in his opinion, sleep in the experiments of Hess represents a specific case of sleep produced reflexly by means of stimulation of a definite area of the nerve tracts with the current.

The method of electric sleep according to our conception was also studied and used in subsequent years by many authors.

In studying the problem of the utilization of electric sleep for the treatment of patients it is expedient first to analyze the observations in the psychiatric clinic where it was first used and then those in other clinics where this method began to be used much later, after the accumulation of sufficient experience in the application of electric sleep in the psychiatric hospital.

After us, electric sleep was first used in the psychiatric hospital of the Institute of Physiology imeni I. P. Pavlov (Leningrad) by A. S. Chistovich, who confirmed our first observations as to the effectiveness of electric sleep in the therapy of various initial forms of mental diseases. He used electric sleep with considerable effect also in the treatment of alcoholic narcomania.

S. D. Rasin and R. A. Vernikova (1952), S. D. Rasin, A. A. Golubchik and G. G. Fabish (1954) from the department of psychiatry of the Institute of Clinical Physiology of the Academy of Sciences UkrSSR are utilizing electric sleep both according to the methods developed by us and according to the methods which they have modified, wherein this method is combined with a conditioned-reflex sleep elaborated on the basis of it. The authors obtained a good therapeutic effect in patients with psychogenic reactions and exogenous

psychoses as well as in certain patients with schizophrenia.

M. V. Korkina from the psychiatric hospital of the Second Moscow Medical Institute imeni N. I. Pirogov studied electric sleep treatment of various forms of mental diseases. She observed the best therapeutic effect in the reactive and asthenic-depressive states as well as in the functional phase of schizophrenia.

M. I. Rybal'skiy and M. A. Titayeva (Moscow Oblast Neuropsychiatric Hospital imeni Yakovlenko) in the treatment of patients with various mental diseases used electric sleep both independently and in combination with other measures. They observed the best therapeutic effect in patients with psychogenic reactions. The authors obtained a beneficial therapeutic effect also from the use of prolonged electric sleep procedures (lasting up to three to four hours) in patients with considerable psychomotor excitation (in part of them excessive excitation at the beginning of the procedure was eliminated by the intravenous injection of magnesium sulfate).

M. I. Rybal'skiy also made a study of the histologic changes in the brains of dogs subjected to 24-hour electric sleep procedures. The investigation showed that even such prolonged influences did not produce any irreversible changes in the brain with the insignificant current strength required for electric sleep.

Z. A. Kirillova (Institute of Psychiatry of the Ministry of Health USSR) worked out a method of combined application of electric sleep (prolonged routines) with small doses of insulin. Her observations showed that this method gives a good therapeutic effect in schizophrenia in those cases where the application of electric sleep alone is inadequate. She investigated the dynamics of higher nervous activity of the schizophrenic patients in the process of treating them with electric sleep. The results of the investigations showed that during the treatment by this method a normalization of the basic nerve processes in the central nervous system occurs.

L. V. Dymetskaya (Psychiatric Clinic of the Perm Medical Institute) used electric sleep in mental diseases. She obtained the best therapeutic effect in patients with reactive conditions and the asthenic-depressive syndrome. In schizophrenia electric sleep gave a good therapeutic effect only

in the initial stages of the disease. In the hallucinatory-paranoid type, even where the disease was of considerable duration, this method in combination with other measures gave a good therapeutic effect.

L. V. Dymetskaya, studying the neurodynamics of electric sleep by the method of investigation of higher nervous activity, established three degrees of depth of sleep: drowsy state, superficial hypnotic sleep, and deep sleep. The results of her investigations were presented at the 16th Conference on The Problem of Higher Nervous Activity of The Academy of Sciences USSR (1953).

D. V. Afanas'yev (Psychiatric Hospital of the L'vov Medical Institute), continuing his investigations in the field of electronarcosis, began to use the method of small dosages of the current, that is, electric sleep. The author obtained a good therapeutic effect from electric sleep in patients with various forms of neuroses and psychogenic reactions as well as in morphine addicts during the period of abstinence.

In 1953, Z. A. Kirillova, A. N. Korganova and E. Ya. Shuin' (Institute of Psychiatry of the Ministry of Health USSR) published the results of observations on the effectiveness of the use of electric sleep in rheumatic encephalitis (chiefly, the choreic form) in a pediatric psychiatric clinic. The authors note that the children fell asleep rapidly and deeply and were very enthusiastic about this therapeutic procedure. A therapeutic effect occurred most often in the choreic form of rheumatic encephalitis -- even after six or seven procedures a considerable reduction in hyperkinesias was observed. The clinical improvement was accompanied by a normalization of metabolism (if the metabolism had been disturbed); normalization occurred in any case but somewhat later in the treatment. The authors also studied the dynamics of higher nervous activity of sick children which corresponded to the improvement in their general condition.

L. Ya. Rabichev (Perm Oblast Children's Hospital) used electric sleep effectively in the choreic form of rheumatic encephalitis as well as in a number of other nervous diseases of children. He organized a city clinic for the treatment of children by electric sleep under outpatient conditions.

I. A. Diordienko (Stavropol' Oblast' Hospital) used elec-

tric sleep with beneficial results in patients with neurasthenia and noted a reduction in the oscillatory (arterial) index during the procedure.

At the present time, electric sleep is being used successfully in many psychiatric hospitals, particularly in Moscow and in Moskovskaya Oblast'. Note should be made particularly of the favorable experience in the use of electric sleep under outpatient conditions (Neuropsychiatric Dispensary of the Krasnopresnenskiy and Moskvoretskiy Rayons of Moscow).

In 1954, N. M. Liventsev, V. S. Vozdvizhenskaya and A. F. Strelkova (Neurological Clinic of the State Institute of Physiotherapy) published the results of their long experience in the use of a pulsating current (electric sleep) in patients with the sequelae of traumatic injuries of the brain without organic changes in the brain in the last period of the disease. They observed a stable effect: headaches disappeared and the night's sleep became normal, which had constituted the main complaints of the patients. Thereby, the examination of electrical activity of the brain and motor chronaximetry showed a normalization of the functional state of the brain.

M. Z. Konovalova (Surgical Clinic of the Kazakh Academy of Sciences) has successfully used electric sleep in the concussion-contusion syndrome as a result of acute brain trauma.

A. S. Berkhoon (Central Scientific Research Institute of Prosthetics and Prosthesis Construction) used electric sleep in local and phantom pains in 55 patients with amputated extremities as well as in a number of patients with indolent ulcers of the stumps. Beginning with the sixth or seventh procedure of electric sleep a considerable reduction was noted in the pains and an improvement in the general condition. In approximately 70 percent of the patients at the end of the course of electric sleep (16-20 procedures) a permanent disappearance of the pains occurred which facilitated the use of prosthetics. A prolonged therapeutic effect of electric sleep after a more prolonged course of therapy (24-30 procedures) was observed also in patients with indolent ulcers, which decreased considerably in size and in certain patients completely closed.

Ye. A. Beyul and L. F. Limcher (1954) (Clinic of Therapeutic Nutrition of the Institute of Nutrition of the Academy of Medical Sciences USSR) published the results of their

first experience in the use of this method of treatment in combination with diet in patients with hypertensive disease. Electric sleep not only contributed to a general improvement in the condition of the patients (elimination of headaches, normalization of night's sleep, etc.) but also produced a stable reduction in arterial pressure which was maintained for a long time. The beneficial effect of treatment coincided with the normalization of electrical activity of the brain.

V. A. Oleneva from the same therapeutic nutrition clinic of the Institute of Nutrition of the Academy of Medical Sciences USSR made observations on the use of electric sleep in 25 patients with pronounced clinical manifestations of peptic ulcers of the stomach and duodenum (with the presence of a niche). All the observations and investigations were made with the observance of an ulcer diet according to the system used by the therapeutic nutrition clinic. The patients tolerated the electric sleep well; in seven of them sleep occurred promptly after the apparatus was turned off and lasted, on the average, for two hours. Certain patients fell asleep from 30 minutes to one hour after the current was turned off. In eight persons a drowsy condition occurred first which gradually passed into sleep.

Under the influence of electric sleep it was possible to see definite beneficial changes in the condition of the neuropsychiatric sphere of the patients. They became calmer; an alert cheerful mood and a belief in their final recovery appeared. The vegetative disturbances (perspiration, salivation) and the hypo-hyperglycemic syndromes decreased. Beginning with the fifth to sixth day of treatment with electric sleep a considerable clinical improvement occurred in the majority of patients: the pains and dyspeptic signs disappeared, the tenderness was reduced. At the time of discharge the pain syndrome had completely disappeared in all of those treated. However, no particular beneficial effect of electric sleep on the healing of the ulcer could be noted.

On the basis of his observations the author draws the conclusion that electric sleep exerts a notable beneficial influence on the subjective manifestations of the disease and, as a whole, gives a better therapeutic effect than the use of differentiated dietary therapy alone.

Considerable research on the use of electric sleep in the treatment of patients with hypertensive disease has been carried out by G. V. Sergeyev in the Institute of Therapy of

the Academy of Medical Sciences USSR. The preliminary data of this investigation are presented below.

The effectiveness of electric sleep in the treatment of patients with hypertensive disease has been studied by L. A. Studnitsyna in the hospital of the State Institute of Physiotherapy.

M. V. Russkikh (Institute of Neurology of the Academy of Medical Sciences USSR) is using electric sleep in the treatment of patients with neurosis of different types as well as in insomnia which does not submit to therapy with any pharmacologic measures.

Electric sleep in certain surgical diseases (gastric ulcer, indolent ulcers, etc.) is being used in the Institute of Surgery of the Academy of Medical Sciences USSR imeni V. A. Vishnevskiy.

An investigation of the electric sleep method is also being made in the All-Union Scientific Research Institute of Experimental Surgical Apparatus and Instrumentaria.

It is interesting to note the experience in use of this method in the practice of rural public health. K. A. Ivanov-Muromskiy and S. R. Roytenburd (1956) published data concerning the beneficial therapeutic effect of the use of electric sleep in various diseases, particularly in the pre-operative period, in the practice of a rural hospital.

In recent years, works have appeared on electric sleep in the foreign press also.

In 1952, Z. Servit reported the results of his experimental work in the field of electric sleep at the Physiological Congress in Prague. Being interested chiefly in problems of the mechanism of action of the current he performed a number of experiments on animals. By means of local anesthesia of the tissues in layers and trephination of the skull bones he established the fact that the effect of the pulsating current on the brain rather than on the peripheral nerve receptors, as certain authors had supposed is of chief importance in the mechanism of electric sleep.

In subsequent years (1953-1956 Z. Servit continued his investigations in the field of establishing the physiological nature of electric sleep and using it clinically for

various diseases. Similar investigations are being carried out by Ya. Khadlik. The results of these observations have been published in 1956 in Prague in a collection on the therapeutic use of various types of sleep.

According to the information available to the authors work is being done on electric sleep in Poland, Rumania, Bulgaria and the German Democratic Republic.

In concluding this review of the literature, which deals with the current state of the problem of electronarcosis and electric sleep, it should be emphasized that the study of electronarcosis was an essential historical premise for the development and clinical adoption of the method of electric sleep, because it made it possible to establish the fundamental character of the effect of the electric current on the central nervous system when currents of moderate and considerable strength were used. However, further study of this problem has shown that the quantitative alteration of the current strength alone -- a considerable reduction of it -- can lead to qualitative changes and can produce a condition very similar to physiological sleep instead of the forced pathological condition of electronarcosis. In this connection, the teaching of I. P. Pavlov on the nature of inhibition and of sleep has been of great importance, making it possible to give a sound basis to the physiological effect of a current of insignificant strength, which underlies the method of electric sleep.

CHAPTER II

Physiological Bases For the Method of Electric Sleep. Apparatus, Technique of Administration of It.

In studying the mechanism of occurrence of physiological sleep I. P. Pavlov ascribed considerable significance to the prolonged effect of monotonous indifferent stimuli. Thus, in lectures on the work of the cerebrum I. P. Pavlov writes: "foreign stimuli which may be repeated without further consequences for the animal also through their own effects alone lead to the development of an inhibitory condition in the cortex". (I. P. Pavlov. "Collection of Works," 1947, Vol IV, p 99).

"Prolonged stimulation of the same points in the cortex leads to a very profound inhibition of them, which, naturally, by irradiating vigorously, encompasses the cerebral hemispheres and descends to lower brain centers". (*Ibid.*, p 221).

"Further, it is generally known that weak and monotonous stimuli make people sluggish, sleepy, and some actually fall asleep". (*Ibid.*, p 327).

Therefore, in I. P. Pavlov's teaching about inhibition and sleep there is a profound physiological basis for the possibility of using a weak electric current in the capacity of an indifferent monotonous rhythmical stimulus in order to produce a diffuse inhibition of the cerebral cortex which changes over into sleep. This possibility has been shown in a number of investigations by workers in the laboratory of I. P. Pavlov.

These observations were first performed by M. N. Yerofeyeva (1912). She wrote: "stimulation of the skin of a dog with a faradic current of the strength (weak) which we used possesses a dual effect: not only is a conditioned salivary reflex formed in response to it but it also produces a sleep reflex".

V. K. Fedorov (1933) mentions the further observations of N. A. Pockopayev and L. N. Fedorov in this field. In summarizing the results of the data which exist on this problem as well as his own observations, he writes: "Therefore, our experiments show that a weak electric stimulation of the skin, which is addressed to all types of cutaneous sensation,

that is, tactile, thermal and other nerve endings, can exert such a considerable inhibitory effect on the higher central nervous system centers (primarily, on the cerebral cortex), that afterwards even the individual components of this complex stimulus, that is, stimulation of tactile and thermal nerve endings if performed at the site of effect of an electric current acquires a strong soporific effect".

In the physiotherapy literature there are indications that the effect of a direct electric current with the electrodes arranged transcerebrally sometimes produces sleepiness. A pulsating current, which possesses a stronger physiological effect than a direct current, can also be effective in this respect.

In the opinion of a number of research workers (A. Ye. Shcherbak, A. R. Kirichinskiy and others), when the electrodes are arranged transcerebrally or oculo-occipitally the current enters the skull through the orbital fissure and the foramina in the orbits as well as through the thinner bones forming the walls and base; it leaves through the foramen magnum and the thin cellular bones of the mastoid processes. This is the best method of bringing the current into the skull and of making it penetrate into the brain substance.

Our investigation showed that when the generally accepted arrangement of the occipital electrode is used beneath the hairy part of the head, a considerable portion of the current branches off and passes through the soft tissues surrounding the skull.

An arrangement of the occipital electrode in the form of a split plate applied directly to the area of both mastoid processes, which has been adopted in our method, is more effective.

The next problem in the method was a choice of the characteristics of the pulsating current.

After adopting the ocular-occipital [the literal translation is "orbito-occipital"] arrangement of electrodes as the one which best assures the possibility of maximum penetration of the current into the skull and after taking into consideration the necessity of a prolonged effect of the current and attempting to reduce the electrochemical influence of it to a minimum, we decided on the so-called "pulsating current".

The latter consists of brief rectangular impulses of current separated by relatively long pauses. The current increases to its maximum value (amplitude) almost instantaneously, is very briefly (thousandths of a second) at this level, and just as quickly drops to zero. Schematically the graph of the current is similar to that shown in Fig. 1. Thanks to the long pause between the impulses the average value of the current strength in this case is hundreds of times less than the amplitude of the impulses. At the same time, as has been established in electrophysiology, this form of the current possess the strongest effect on nerve structures. However, the frequency of repetition of the impulses as well as the duration of the individual impulse should correspond to the character of the electrical excitability of a given nerve structure, or, according to N. Ye. Vvedenskiy of its lability.

N. Ye. Vvedenskiy studied the lability of the peripheral nerve trunks in detail, for which he established an optimum frequency of 80-100 stimuli per second (in other words, current impulses). With respect to structures of the central nervous system (according to his expression, "nerve centers") he indicated only that their lability is considerably less. In addition, it is known that the rhythmical nature of nerve processes in the brain, an expression of which is constituted by its action potentials, may be changed within very broad limits, whereby so-called "fast waves" (30-40 cycles a second or more) correspond to the state of excitation, while low-frequency waves, on the other hand, of the order of several cycles per second (the so-called "slow waves" and α -waves) correspond to the state of inhibition and sleep.

These considerations tended to make us select relatively low frequencies for the pulsating current. During the course of the work, in investigating the effect obtained from the action of pulsating currents of different frequencies, we established the fact that in this case individual differences occur, and the best method is to select the frequency experimentally for each patient during the first two or three procedures. Frequencies of from one to two to 100-130 cycles per second may be used for producing electric sleep. According to our observations, the best effect is obtained through the utilization of frequencies within limits of from 5 to 25 cycles per second.

The duration of the impulse used was kept constant (in order not to complexify the apparatus with regulating instru-

ments) within limits which correspond to the motor chronaxie of the central nerve structures and amount to 0.3-0.5 meter/second. Longer impulses produce unpleasant sensations, and shorter ones are not very effective.

We consider the effect of a weak current, the upper limit of which is the threshold at which restlessness or unpleasant sensations occur in the area through which the current passes, to be specific for the method of electric sleep (in contrast to electronarcosis); that is, the current strength is determined as one which does not produce any unpleasant sensations during its passage (it will be described in greater detail below) and which does not interfere with the advent of sleep. This threshold current strength, naturally, is regulated individually not only in each patient but also in each procedure.

The principal characteristics of the current used in electric sleep are the following: a) a pulsating current of rectangular shape; b) frequency of impulses from 5 to 25 cycles per second (within broader limits from 1 to 130 cycles per second); c) the duration of the impulses in constant within limits of 0.3-0.5 meter/second; d) the current strength is regulated individually in each procedure.

A pulsating current of such a character may be obtained by means of various electron-tube (radio tube) systems. Therefore, at the present time various organizations are producing various types of apparatuses which give a pulsating current with characteristics necessary for electric sleep.

Below, we are describing the apparatus developed with our participation and produced by the experimental workshop of the State Institute of Physiotherapy.

During the process of spread of the method of electric sleep and the accumulation of experience the arrangement of the apparatuses was changed somewhat, although the main current characteristics remained unchanged.

While we are omitting a description of our first apparatuses (see first edition), we are presenting diagrams and a description of the arrangement of three types of apparatuses which were produced in 1950-1951, 1952-1953 and 1954-1955 by the workshop mentioned above. The layouts of these apparatuses are similar in principle and are different only

in a part of the regulating and measuring devices. All the apparatuses are arranged so that they allow the possibility of carrying out therapeutic procedures simultaneously on four patients. As the practice of using the apparatuses has shown, this is the most convenient. Thereby, electric sleep is carried out in a three-four-bed ward on all the patients simultaneously.

The basis of the circuit of the apparatus is a blocking oscillator which is represented by a self-excited relaxation type oscillator, without tuned circuits at the plate and grid circuits, and with a strong feedback. The distinguishing characteristic of the blocking oscillator is the fact that, because of strong coupling of the plate and grid circuits, and with a strong feedback. The distinguishing characteristic of the blocking oscillator is the fact that, because of strong coupling of the plate and grid circuits, the processes of increase and decrease of the current in the plate circuit are of quite an abrupt nature. As the result of this, the blocking oscillator is used in the circuits for the purpose of obtaining brief impulses of rectangular shape. The blocking oscillator in this case has advantages over a multivibrator (another widespread system for obtaining brief impulses) because of the great "porosity" of the current, that is the low frequency with the small duration of the impulses.

The layout of the apparatuses released in 1950-1951 (Fig. 2) consists of four independent blocking oscillators constituted by 6N8 tubes and fed by a common rectifier.

The 6N8 tube (3) consists of twin triodes. One-half of the tube (one triode) serves as the blocking oscillator proper; the other half of it (second triode) is used as an output amplifier.

An interelectrode transformer (15) is hooked up in the plate circuit of the blocking oscillator; this transformer has three windings: plate, winding of the blocking oscillator, and grid winding of the amplifier. The plate winding is hooked up to the positive pole of the feed voltage. A condenser (16) is hooked up in series with the grid winding of the blocking oscillator; a leak resistance (14), made in the form of a potentiometer serving for the regulation of the frequency of the impulses generated by the blocking oscillator, is hooked up in parallel with the grid. The time constant of the impulse (about 0.5 meter/second) is condi-

tioned by the parameters of the blocking oscillator.

Impulses from the blocking oscillator are fed to the amplifier grid by means of the third winding of the interelectrode transformer. An output controlling potentiometer (10) is hooked up into the plate circuit of the amplifier. A bias resistor (13) and a bridging capacitor (17) are hooked up into the cathode circuit of the amplifier.

In addition, an independent bias is fed to the amplifier grid through the resistor (12).

For the purpose of regulating the operation of the circuits and for indicating the frequency of impulses a 6E5 tube, the so-called "magic eye," is hooked up to the amplifier grid. The tubes are connected through twin rectifiers (2). The entire system is supplied by a vacuum tube rectifier (4) and is connected to the city power supply.

The external appearance of the apparatus is presented in Fig. 3. On the control panel there are a power switch (5) and four control compartments corresponding to the four channels of the apparatus. In each compartment there are the following from above down: the eye of indicating lamp (1) potentiometer knob for controlling frequency (2), output potentiometer knob (3) and terminals for attaching the leads from the electrodes (4).

We are presenting the specifications of the composite parts of the layout in Fig. 2.

No on the dia- gram	Name of Part	Type, Electrical Data
1	Tube.....	6E5
2	Tube.....	6Kh6
3	Tube.....	6N8
4	Tube.....	5Ts4S
5	Power transformer.....	100 watts, 250 volts
6	Filter choke.....	
7	Switch.....	
8	Condenser.....	KE; 10 microfarads, 500 volts
9	Fuse.....	0.25 ampere
10	Potentiometer.....	wire wound; 3000 ohms

[continued next page]

No on the dia- gram	Name of Part	Type, Electrical Data
11	Resistor.....	200 megohms, 0.5 watts
12	Resistor.....	20 megohms, 2 watts
13	Resistor.....	500 ohms, 1 watt
14	Potentiometer.....	2 megohms
15	Interstage transformer	
16	Condenser.....	0.1 microfarads, 250 volts
17	Condenser.....	10 microfarads, 50 volts
18	Resistor.....	0.5 megohms
19	Resistor.....	0.1 megohms
20	Condenser.....	5,000 micromicrofarads

The apparatuses which were put out in 1952-1953 were supplied with an oscilloscope for the direct measurement of the amplitude values of the current impulses during the procedure. The measurement of the current strength during the procedure is particularly important, because at this time the patient is sleeping, and it is not possible to judge the current strength by his sensations. The oscilloscope is adapted for the measurement of voltage. However, in this case specifically the current strength should be measured, because when there is a poor contact between the electrodes and the patient's skin the voltage at the electrodes may remain unchanged, whereas the current passing through the patient may be either considerably weakened or even completely absent.

The following system is used for measuring the current strength by means of the oscilloscope. A resistor of definite magnitude is connected in series to the patient's circuit (more accurately, into the circuit of the output terminals of the apparatus). The voltage drop created in it (which is directly proportional to the current strength according to Ohm's Law) is measured by the oscilloscope. Such a system makes it possible to utilize a single tube for the measurement in all four channels of the apparatus. The measuring circuit of the resistor in each channel is connected to the oscilloscope by means of a special switch. During the procedure the oscilloscope is sequentially switched into all channels periodically every 10-15 minutes, and, therefore, the current strength is regulated in them periodically. The oscilloscope is used without time scanning of the impulses, which considerably simplifies the system for connecting

it up. A scale is affixed to the oscilloscope screen, and on it a beam of light indicates the current strength as the amplitude value of the impulses.

The main electrical circuits of the apparatus are presented in Fig. 4. In the part which generates the pulsating current the layout is similar to the preceding one, with the exception of the fact that the interstage transformer of the blocking oscillator has two windings. The negative lead in the circuit is not grounded to the chassis. There are no indicating lamps in the system. A resistor (10) of constant value for the measurement of the current strength is hooked up into the output circuit of each channel of the apparatus.

The oscilloscope is fed by an individual rectifier through an appropriate system of voltage divider resistors. The measuring circuits from each channel are connected to the oscilloscope through a switch (29) and an amplifying circuit.

We are presenting the specifications of the parts in the layout of Fig. 4.

Nos on
the
dia-
gram

Name of Part

Type, Electrical Data

1	Tube.....	5Ts4S
2	Tube.....	6N8
3	Filter choke.....	
4	Power transformer.....	100 watts
5	Twin rectifiers.....	
6	Resistor.....	5,000 ohms, 1 watt
7	Resistor.....	20,000 ohms, 2 watts
8	Resistor.....	300,000 ohms, 0.25 watt
9	Resistor.....	2,000 ohms, 1 watt
10	Resistor.....	1,000 ohms, 0.5 watt
11	Resistor.....	20,000 ohms, 0.25 watt
12	Resistor.....	50,000 ohms, 2 watts
13	Resistor.....	50,000 ohms, 1 watt
14	Resistor.....	100,000 ohms, 0.25 watt
15	Resistor.....	1,000 ohms, 0.5 watt
16	Resistor.....	4,000 ohms, 0.5 watt
17	Resistor.....	500,000 ohms, 0.5 watt

[continued next page]

Nos on
the
dia-
gram

	Name of Part	Type, Electrical Data
18	Resistor.....	60,000 ohms, 0.25 watt
19	Condenser.....	Electrolytic; 10 microfarads, 450 volts
20	Condenser.....	Electrolytic; 10 microfarads, 150 volts
21	Condenser.....	Paper 0.1 microfarad, 250 volts
22	Condenser.....	Paper 2,500 micromicrofarads, 400 volts
23	Condenser.....	Paper 0.01 microfarad, 1000 volts
24	Condenser.....	Paper 0.5 microfarad, 400 volts
25	Potentiometer.....	Omega; 5 megohms
26	Potentiometer.....	Wire bound, 3,000 ohms, 1 watt
27	Transformer for oscil- lotron feed.....	
28	Switch with five posi- tions.....	
29	Electron-beam tube....	8 LC-29

In comparison with the preceding layout the following changes were made in the layout of the apparatuses put out in 1954-1955 and shown in Fig. 5. The blocking oscillator has been made common to all four channels. The measuring circuits have been hooked up to the oscilloscope through a transformer (32). Capacitors (31) have been hooked up into each channel at the output terminals; these elements protect the patient's circuit against the direct component of a current which may arise in the event of any injuries to the component parts of the apparatus. A voltage regulator (8) has been hooked up in parallel with the output terminals, protecting against the possibility of an increase in voltage in the patient's circuit also in case of any accidental damage to the apparatus.

We are presenting the specifications of the parts for the layout shown in Fig. 5.

Nos on
the
dia-
gram

	Name of Part	Type, Electrical Data
1	Tube.....	5Ts4S
2	Tube.....	6N8S
3	Power transformer.....	
4	Transformer of block- ing oscillator.....	
5	Resistor, variable....	SP-1, 4,700 ohms
6	Resistor.....	VS-0.25, 500 ohms
7	Capacitor.....	KBG-N, 0.7 microfarad, 500 volts
8	Voltage regulators....	SG-2S
9	Capacitor.....	Electrolytic, 10 microfarads, 450 volts
10	Resistor.....	VS, 0.25, 10,000 ohms
11	Resistor.....	VS-2, 50,000 ohms
12	Resistor.....	VS-2, 8,000 ohms
13	Filter Choke.....	
14	Resistor.....	VS-1, 50,000 ohms
15	Resistor.....	VS-0.25, 500,000 ohms
16	Capacitor.....	KBG, 1 microfarad, 500 volts
17	Capacitor.....	KSO-3, 200 micromicrofarads, 1,000 volts
18	Resistor.....	VS-1, 100,000 ohms
19	Capacitor.....	KSO-13, 10,000 micromicrofarads, 1,000 volts
20	Resistor, variable....	SP-1, 0.5 megohms
21	Resistor, variable....	VS-0.5, 2 megohms
22	Resistor, variable....	VS-0.5, 1 megohm
23	Resistor, variable....	VS-0.5, 0.5 megohm
24	Electron beam tube....	8 L0-29
25	Switch with five posi- tions.....	
26	Switch with seven po- sitions.....	
27	Toggle switch.....	
28	Voltage-changer switch	
29	Fuse.....	2 amperes
30	Neon tube.....	MN-7
31	Capacitor	KBG 0.5 microfarad-500 volts
32	Pulse transformer	

An external view of the apparatus is presented in Fig. 6.

In the middle of it, in the upper part of the control panel is located the screen of the oscilloscope. To the right of it, the oscilloscope switch; to the left, the knob of the impulse frequency regulator. The output potentiometers and terminals for attachment of the leads from the electrodes are placed below them.

The stepwise regulation of the frequency simultaneously in all the channels of the apparatus made it possible to simplify the latter considerably; however, it did not prove itself in practice. Therefore, beginning with 1957 the apparatuses began to be produced only with individual frequency regulation, that is, with individual blocking oscillators in the circuit of each channel. Otherwise, their layouts correspond to that presented in Fig. 5.

The electrode set for electric sleep consists of an ocular and occipital electrode. The ocular electrode (Fig. 7) consists of an elastic belt (1) with two bands, in which there is a slot for the bridge of the nose and to which two plastic rings (2) have been attached at an appropriate distance from each other. The contact portions of the electrodes (3) are attached to the latter; they are made of a thin plate of stainless steel having the shape of small cups into which loose cotton tampons moistened with water or physiological solution are placed. The cotton is in contact with the skin of the closed eyelids and serves as a conductor for the current from the metal parts of the electrodes. The ends of a soft split lead (4), by means of which the electrode is attached to the apparatus, is soldered to the latter.

The occipital electrode is split; it is applied to the skin in the area of the mastoid processes, that is behind the aural conchae below the midline of the latter. Each portion of this electrode consists of a small lead plate of oval shape (5) and has been placed in a recess of a special ear cap (6). Loose cotton tampons, also moistened with water or physiological solution, are applied to the plates in the recesses of the ear caps; the ends of a split lead (7) are soldered to the plates for the purpose of attachment of the electrode to the apparatus. The occipital electrode holder consists of a rubber band which is attached to the head by three small straps; the latter are fastened in the parietal and occipital areas and under the chin by means of buckles and studs.

The electrodes are applied to the head and fastened in such a way as to insure their complete contact without troubling the patient through the very tight application of straps or bands (Fig. 8). During prolonged procedures the cotton tampons which have been applied under the ocular and occipital electrodes are moistened with water or physiological solution (through special openings existing in the electrodes themselves) by means of a pipette every 20-30 minutes. The lead for the ocular electrode is attached to the negative (minus) terminal of the apparatus; that from the occipital lead, to the positive (plus) terminal.

It should be kept in mind that the therapeutic effect of the procedure depends to a considerable degree on the proper application of the electrodes, their adequate moisture and their constant good contact with the skin throughout the entire procedure regardless of the position of the patient's head. If the patient complains of a sensation of pressure any place during the application of the electrodes the position of the ocular or occipital bands needs to be changed and the complete comfort of the patient assured.

After the application of the electrodes and after the attachment of them to the apparatus preparation is made for switching on the current.

First the necessary frequency of the pulsating current is established. This is done by means of the appropriate knob on the control panel of the apparatus which is set at an appropriate division on the scale. The frequency which is most effective in putting the patient to sleep is determined at the time of the initial procedures, and it is maintained subsequently. Switching on the current and the regulation of a suitable strength of it is carried out by means of turning the knob of the control potentiometer in the appropriate "channel" of the apparatus.

The strength of the pulsating current in electric sleep is regulated in accordance with the patient's sensations. With proper application of the electrodes the sensations from the passage of the pulsatile current are localized in the depth of the orbits and have the nature of "vibrations," "tapping," "pressure," et cetera. For the best therapeutic effect it is desirable to make use of the greatest possible current strength. However, it should not produce any unpleasant sensations in the patient (if unpleasant sensations occur in the bones of the occiput or face the positions of

the electrodes should be checked). The strength of the pulsating current is expressed in microamperes. The amplitude value of the impulses is measured by means of the oscilloscope, and they amount, on the average, to 10-15 ma. Throughout any one operation the current strength should be maintained constant or even increased somewhat. An insignificant increase in the current strength is expedient with the performance of each subsequent procedure (without, however, altering the main condition -- the absence of unpleasant sensations).

The current strength is judged by the light beam on the screen of the oscilloscope, which first should be switched over to the appropriate channel. After establishing the necessary current strength the oscilloscope may be cut out (or switched over to another channel). During the procedure the oscilloscope is repeatedly and periodically (every 10-15 minutes) hooked up to the channel regulating the current strength. If the latter has decreased it should be adjusted by the potentiometer or the electrode padding should be moistened again. Before moistening the latter the current strength should be reduced somewhat.

In subsequent procedures (beginning with the fifth-sixth), when a conditioned reflex for sleep has been elaborated in the patients, the current may be turned on for a shorter time. At the end of the procedure, usually after the patient himself has awakened, the electrodes should be removed. Thereby the patient should be warned not to look immediately at the bright light, because his eyes, after being closed for a long time, adapt only gradually to the bright light.

Certain patients mention that during the first few moments after the ocular electrodes are removed they "see indistinctly". This is associated either with too sharp a transition to bright illumination or with the entrance of water or physiological solution, with which the electrode padding is moistened, under the lids. This situation rapidly disappears in all cases, and no procedures are required.

An obligatory condition for the successful administration of electric sleep is the comfortable position of the patient. He should be told that his position may be changed and that he should make himself as comfortable as possible.

Under outpatient conditions the procedures may be performed on a soft couch. The patient should have any tight

clothes removed, and should be well covered with a blanket. The urinary bladder should be emptied before prolonged procedures.

In hospitals the procedure is performed in bed. The patient undresses and lies down as though for his night's sleep. Usually, electric sleep is administered simultaneously to a group of patients in a separate half-darkened ward. Complete quiet must be observed in the ward where the treatment is being given as well as in adjacent rooms.

The ward in which the electric sleep is being administered should be serviced by a nurse whose duty it is to observe the operation of the apparatus and the sleep of the patients. In exceptional cases, a qualified and appropriately instructed orderly may be appointed to watch the apparatus under conditions that the patients be periodically checked by a nurse or a physician. For the first procedure the application of the electrodes and the regulation of the current strength may be entrusted only to an appropriately trained nurse.

The procedures are usually conducted every day between breakfast and lunch. Their duration varies within broad limits and depends on the nature of the disease and the characteristics of the patient's nervous system. Thus, for example, in the treatment of patients with traumatic disease of the brain (sometimes, hypertensive disease), particularly when they have headaches, increased irritability, et cetera, the use of the apparatus is limited to 40 minutes-one hour. The average duration of the treatment is $1\frac{1}{2}$ -2 hours, and in certain neuropsychiatric diseases, to three or four hours. At the end of the procedure, that is, after the current has been turned off, the patients should sleep until they awaken spontaneously.

The problems of the medical indications for the use of electric sleep are pointed out below. In view of the setting of one of the electrodes in the area of the eyes and the passage of the current through the orbits the possibility of administering electric sleep when there are any diseases present in this area should be decided in conjunction with an ophthalmologist.

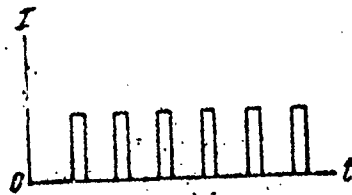


Fig. 1. Schematic Diagram of Pulsating Current Used in Electric Sleep.

On the abscissa the time (t) is plotted; on the ordinate, the instantaneous values of the current strength (I).

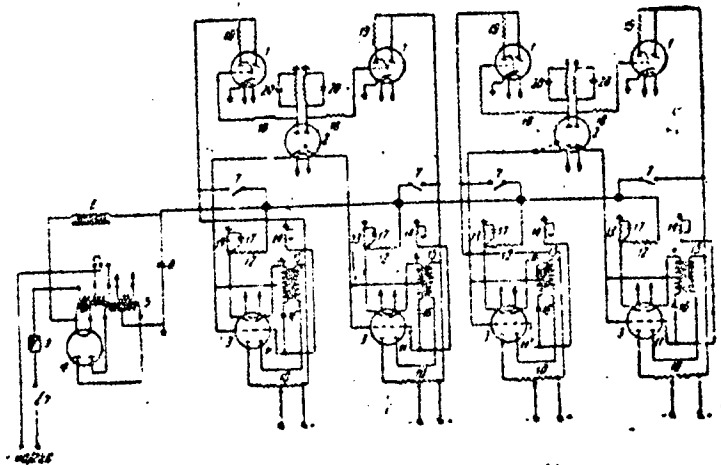


Fig. 2. Main Electrical Circuits of Apparatus for Electric Sleep Produced in 1950-1951 by the State Institute of Physiotherapy (explanation in Text).

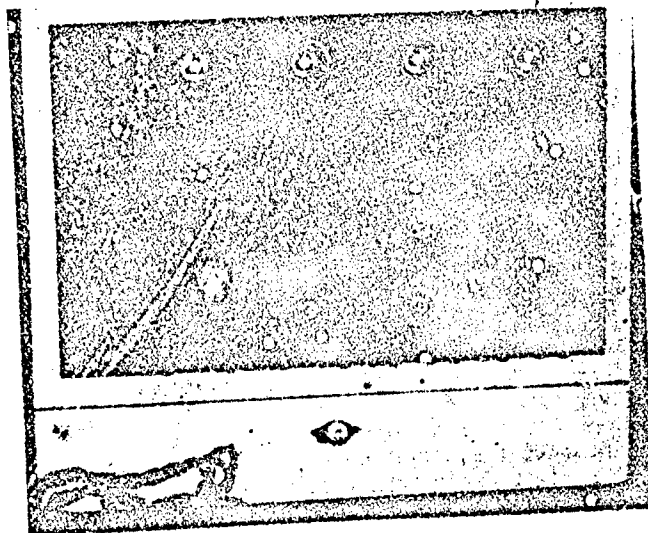


Fig. 3. General View of the Apparatus for Electric Sleep Produced by the State Institute of Physiotherapy 1950-1951.

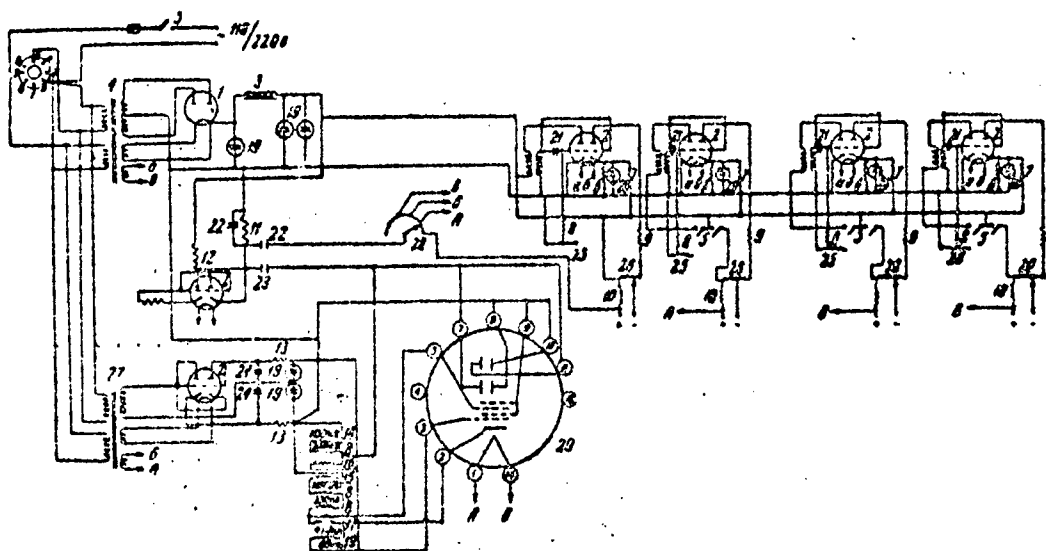


Fig. 4. Main Electrical Circuits of Apparatus for Electric Sleep Produced 1952-1953 by the State Institute of Physiotherapy (Explanation in Text).

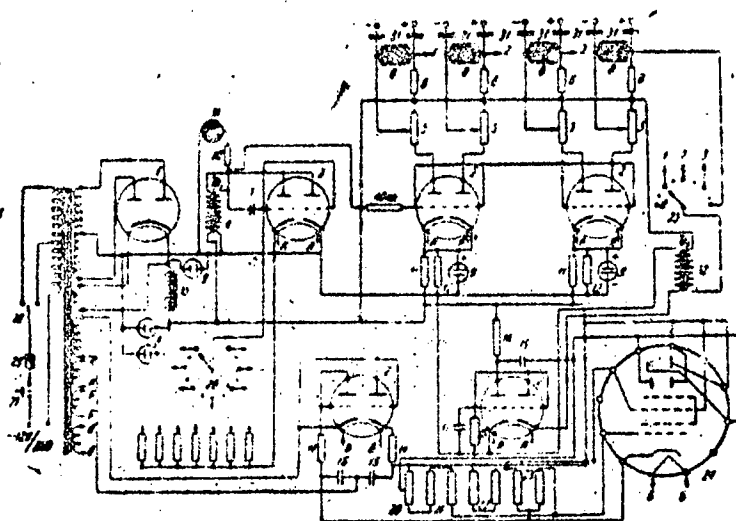
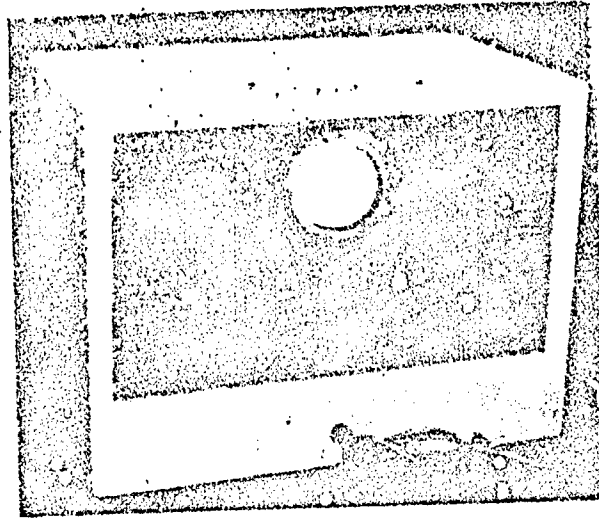


Fig. 5. Main Electrical Circuits of Apparatus for Electric Sleep Produced by State Institute of Physiotherapy 1954-1955 (Explanation in Text).



13. 6. General View of Apparatus for Electric Sleep Produced 1954-1955 by State Institute of Physiotherapy



13. 7. Set of Electrodes for Electric Sleep (Explanation in the Text).

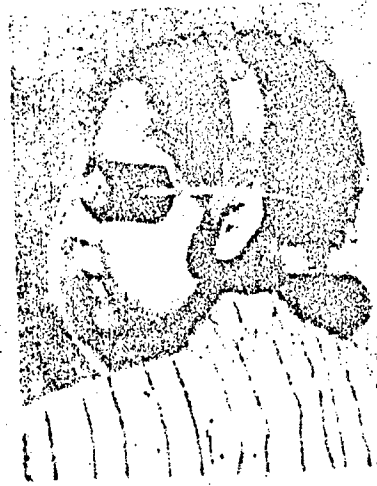


Fig. 8. Electrodes for Electric Sleep Attached to the Head.

CHAPTER III

A Physiological Characterization of Electric Sleep

1. The General Nature of the Condition in Electric Sleep

The following are noted in man during the administration of electric sleep: when the current is turned on and gradually increased in strength sensations of vibrations, shocks or formication appear under the ocular electrodes or in the depth of the orbits; these sensations increase but do not reach the degree of being unpleasant. The strength of the current is limited by the presence of these sensations. As the result of becoming accustomed to them these sensations later become weaker. Gradually, the sensation of heaviness of the lids, ideas of "going off" appear, sometimes a mild dizziness occurs, and a drowsy state supervenes, which gradually deepens to the degree of physiological sleep. The patient is in a calm relaxed position, usually on his side; the respiration becomes deeper, slower and more regular; the pulse slows up by several beats a minute.

The current strength used is so insignificant that no unfavorable reactions are produced in the vegetative nervous system under any conditions, nor does any motor excitation or convulsive phenomena occur, which is the main characteristic of the method of electric sleep. The depth of sleep corresponds to the depth of physiological sleep and varies in the same patient; sleep usually becomes deeper with each successive procedure. Waking occurs several minutes after the current is turned off, although often sleep may last for a more or less long time even after the latter is turned off.

Sometimes, particularly during the initial procedures, the patients do not fall asleep nor even become drowsy, and some of them fall asleep only at the end of the therapeutic procedure.

The character of the reaction to the effect of the pulsating current may proceed, in general, according to one of the following four types: 1) without any visible change in the patient's condition; 2) during the passage of the current the patient's condition does not change or only a slight drowsiness is manifested, but sleep occurs at the end of the procedure; 3) during the entire time that the

current is working the condition of drowsiness is present which periodically changes into sleep; 4) during the effect of the current a quite deep sleep is produced which lasts after the current is turned off in many patients.

For the purpose of illustration photographs of certain patients are being presented during the electric sleep procedure (Figs. 9-13).

With respect to the nature of the condition in electric sleep the following may be added to what has been stated above.

1. The absence of any visible change in the patient's condition is noted most often during the initial therapeutic procedures when the patient is becoming accustomed to them, is watchful, and is paying attention to his own sensations. Many patients, without knowing the difference in principle (with respect to current dosage) between electric sleep and electronarcosis and electric shock, are afraid of unpleasant occurrences, et cetera. After being convinced that they do not occur they are reassured, and only then does their condition change; drowsiness and a peaceful sleep appears. Certain patients do not fall asleep at all during the use of the pulsating current.

2. As a rule, in parallel with the administered electric sleep the night's sleep improves and becomes normal if it has been disturbed; we have not observed any deteriorations in the night's sleep after electric sleep.

3. For the most part, children fall asleep even during the first procedure and frequently continue to sleep even after the current has been turned off.

4. In certain patients sleep occurs after the procedure and falling asleep is distinguished by a particular refractoriness.

Based on the number of observations in which various conditions of electric sleep occurred two characteristic types of refractions may be distinguished: 1) sleepiness and drowsiness during the effect of the current, and 2) a similar condition which passes later into sleep.

The nature of the reaction in the same patient during different procedures may change depending primarily on the

circumstances under which the procedure is being accomplished as well as on the neuropsychiatric condition of the patient. In control observations it is difficult to check this, but prolonged clinical observations, at least in a hospital for mental diseases, convinced us of the fact that the therapeutic effect of electric sleep is not directly connected with falling asleep under the effect of the pulsating current.

After the pulsating current procedure, especially when the condition of sleep has been produced, the feeling of well being of the patients improves and a feeling of alertness, freshness and rest occurs. The patients become more active and cheerful. At first, this good condition is maintained only for several hours after the procedure, and then it gradually becomes persistent.

Therefore, the basic nature of the reaction after electric sleep should be considered a condition which is clinically expressed in sleepiness and drowsiness: according to its physiological nature we have tentatively classified it among the so-called "transitional" states between waking and sleep.

In defining physiologic sleep as a process of diffuse inhibition, I. P. Pavlov said: "We have established the indubitable fact that sleep is inhibition which develops throughout the cerebral hemispheres and which penetrates into the brain to a certain depth. In addition, we have had the opportunity of studying also intermediate phases between the waking state and complete sleep in our animals -- hypnotic phases. These forms appear to us, on the one hand, to be various degrees of extension of inhibition, that is, a greater or lesser spread of inhibition both through various parts of the cerebral hemispheres themselves and through various brain centers, and on the other hand, various degrees of intensity of inhibition in the form of different depths of inhibition in the same areas". (I. P. Pavlov. Complete Collection of Works. Published by Academy of Medical Sciences USSR, 1949, Vol III, p 407).

When general sleep inhibition had encompassed the motor-kinesthetic area of the cerebral cortex but still left the other areas of the latter free it was still possible to obtain salivary conditioned reflexes to auditory, visual and other stimuli, but the conditioned motor reaction remained inhibited. A separation of the secretory and the motor

conditioned reactions occurred, as was noted by I. P. Pavlov. Best studied of the transitional states is hypnotic sleep, which may pass into physiologic sleep. Therefore, the comparison of electric sleep with hypnotic sleep seems interesting.

As we have already mentioned above, during electric sleep using the ocularoccipital arrangement of the electrodes the current enters the brain mass chiefly through the thin bone walls and openings in the orbits, and leaves through the cellular bones of the mastoid processes and, possibly, through the foramen magnum. Thereby, the lines of force of the current encompass the brain stem subcortical area most intensively, exerting a stimulatory effect on it. This stimulation produces inhibition of the cerebral cortex by the law of negative induction. Depending on the spread and depth of the inhibition various transitional phases may occur between waking and sleeping, which are outwardly expressed as sleepiness, drowsiness, and, finally, with sufficient irradiation of the inhibition, as sleep.

V. A. Gilyamovskiy's suggestion that electric sleep be utilized without producing prolonged or deep sleep, similar to the methods of classic sleep therapy for therapeutic purposes as a measure based on the salutary properties of protective inhibition, is in line with the current tendencies existing also in the field of pharmacologic sleep of proceeding from prolonged routines of deep anesthetic sleep to routines of light fractionated sleep combined with physiologic, conditioned reflex, hypnotic sleep, et cetera. Thus, for example, B. N. Birman in his article "The Role of Hypnotic and Sleep Inhibition in the Pathogenesis and Therapy of Neurotic Syndromes" mentions that he has not attempted to produce very deep inhibition in all cases. Good therapeutic results were obtained after the patient had been in a drowsy state or in a state of light hypnotic inhibition for a long time. The combination of therapy with anesthetic and hypnotic sleep gave the best result.

The observations show that even when similar conditions of administration of a pulsating current are maintained the nature of the conditions produced may be different.

The fact deserves attention that in a child sleep occurs particularly rapidly and constantly with the use of a pulsating current.

This corresponds to the characteristics of higher nervous activity of children, in whom, according to the data of N. I. Krasnogorskiy, the inhibitory process irradiates particularly easily. It is understandable that in electric sleep the primary factor affecting the cerebral cells is completely different from that, for example, in hypnotic or in physiological sleep.

All these mechanisms, which are very different according to their method of action on the nerve cell in the area of their primary application, in the final analysis lead to the same effect -- the development of protective inhibition in the nerve cells which is clinically expressed differently depending on the distribution and the depth of sleep (electric sleep, hypnotic sleep, physiological sleep, et cetera).

2. Dynamics of Respiration, Vascular Reactions and Biochemical Changes in Electric Sleep

Research on the physiologic nature of electric sleep and establishment of the mechanism of action of the current can, on the one hand, indicate the direction for further perfection of the method, and, on the other, aid in determining the most effective areas of application of electric sleep clinically. Because the conditions produced from the effect of a pulsating current are outwardly no different from physiological sleep, we came to the conclusion that electric sleep represents a condition of diffuse inhibition of the cerebral cortex. For the purpose of physiologic characterization of this condition we set about using methods of investigation of the states of cortical inhibition.

The objective characterization of the inhibitory states of the central nervous system are of interest not only to physiologists but also to pathophysiologists and clinicians. Through the investigation of the state of inhibition in physiological sleep and in the transitional phases to complete irradiation of sleep inhibition and of protective inhibition in pathological conditions (for example, in certain mental diseases, where therapeutic protective inhibition is used) et cetera, an objective evaluation of the inhibitory state can be given.

Various physiological research methods are used charac-

terizing the inhibitory process. A characterization of conditioned reflex activity was used for this purpose in the laboratories of I. P. Pavlov; specifically by this method transitional phases from waking to sleeping were established and studied -- the hypnotic phases. However, in the research into the inhibitory states in man -- healthy and sick -- these methods offer certain difficulties, because the conditioned stimuli themselves and particularly unconditioned stimuli changed the depth of the inhibitory process. This, specifically, is the method of O. I. Kotlyarevskiy, who studied the depth of sleep in children by means of recording the dynamics of the conditioned reaction to a bell which was elaborated according to the method of speech reinforcement and of conditioned reflexes (plantar and the defensive oculofacial) from directing a stream of air into the face.

In search of a method of graphic representation of the dynamics of sleep inhibition use was made of the method of actography, recording of the winking reactions -- movements of the lids (B. V. Andreyev, I. I. Korotkin), research into motor chronaxie (F. P. Mayorov, M. I. Sandomirskiy), the dynamics of cutaneogalvanic potentials (A. I. Marenina), and others. The electroencephalographic method gives much that is valuable for the purpose of characterizing inhibitory states. We believe that the greater the number of effectors which can be recorded without inconveniencing the subject the more profound and accurate will be the physiological characterization of the condition of the latter.

For the purpose of evaluating the physiological nature of the conditions occurring under the influence of the pulsating current we have used the following research methods: pneumography, plethysmography, electroencephalography; in addition, we have investigated the blood oxygen saturation dynamically in conjunction with E. Ya. Skuin'.

Ye. M. Kreps, M. S. Shipovalov and Ye. A. Bolotinskiy suggested the method of oxyhemometry for the purpose of bloodless observation of the change in the degree of blood oxygen saturation; it is based on the application on the principle of dichromatic (in the green and red portions of the spectrum) photoelectric absorptiometry to living human tissue: in the green portion of the spectrum the coefficient of absorption for oxyhemoglobin and reduced hemoglobin are the same, while in the red portion the absorption of light by oxyhemoglobin is much less than for reduced

hemoglobin. Therefore, the more oxyhemoglobin is contained in the blood the stronger the photoelectric current becomes, which is used to move a galvanometer indicator along a scale graduated in percentages of oxyhemoglobin. Arterial blood which is necessary for the investigation is reached through a dilatation of the capillaries by means of heating the ear.

We should like to discuss the pneumographic changes during sleep. Mosso noted distinct changes in the pneumogram in sleeping persons in the form of the occurrence of a periodic respiratory rhythm. P. I. Nechay described similar characteristics of respiration in sucklings and in people of advanced age. Respiratory changes in the form of occurrence of periodic rhythm have been observed in patients with schizophrenia in the pressure chamber (A. Z. Kolchinskay and S. D. Rasin) as well as in helping persons under the conditions of anoxia (N. N. Sirotinin). A. G. Usov noted the periodic type of respiration with the occurrence of drowsiness in persons of advanced age, and he evaluated it as an expression of diffusion of protective inhibition from the cortex to the subcortex on a background of considerable weakening of central nervous system activity. The periodic fluctuations in a different type of pneumogram have been noted by N. M. Trofimov in the development of hypnoid states in oligophrenics which were expressed in the form of arrhythmic deep inspirations and in correlation with which there were decreases in the plethysmograms. One of us (Yu. Ye. Segal) has described a wave-form type of respiration, similar to the periodic type, in hallucinatory conditions in schizophrenics.

During sleep the plethysmogram is characterized by a tendency toward a gradual rise, the picture of respiratory variations improves, and the amplitude of the pulse waves increases.

O. V. Vertogradova observed the wave-form plethysmographic variations with the occurrence of sleepiness in healthy subjects.

We have obtained the following results. In electric sleep respiration is made somewhat slower and becomes deeper. Sometimes, during the process of falling asleep a periodic wave-form respiration is observed which is characteristic of hypnotic phases. The pulse rate

slows by three to five beats a minute; the pulse quality improves. The electrocardiogram does not change; the plethysmogram shows a slow and gradual dilatation of the peripheral vessels. The electroencephalogram shows, at first, a depression of the α -waves, and then slow waves appear, and after the prolonged effect of the current a certain increase in the fast waves (high frequency waves) is also noted chiefly in the anterior regions of the brain.

All these studies show both an absence of any kind of pathological phenomena (for example as after the effect of a pulsating current of greater strength -- electronarcosis) and the similarity of the nature of electric sleep to physiological sleep.

In addition, our investigations made it possible to establish the normalizing effect of pulsating current when there is a respiratory and vasomotor disturbance, which frequently occurs, for example, in schizophrenics. A normalization (restoration of disturbed regularity to normal) of respiration occurs from the effect of a pulsating current even when no sufficiently deep sleep is produced in the patients. In these patients, who have reactive plethysmograms, the latter assumes a normal character after the effect of a pulsating current: the pulse waves are increased, and respiratory waves appear (the so-called "third order" waves).

In patients with marked disturbances of the respiratory rhythm (frequently superficial respiration which is interrupted by deep inspirations) we have repeatedly observed the approach of the respiration toward normal not only during deep electric sleep but also when the pulsating current did not produce sleep. This, apparently, is one of the physiological changes which explains the therapeutic effect in those patients in whom it has not been possible to produce sleep.

For the purpose of illustration we are presenting the pneumogram of patient K. (Fig. 14). Before the current was turned on the amplitude of the respiratory waves was extremely irregular, and the frequency of them was arrhythmic. One minute and 25 seconds after turning on the pulsating current the respiration became deeper and more rhythmical, despite the fact that the patient did not sleep.

In Fig. 15, a, the pneumogram of patient Kh is presented;

he suffered from a reactive state with prolonged insomnia. As seen from the pneumogram, 20-30 seconds after the current was turned on periodic respiratory rhythm appeared with an irregular amplitude of the respiratory waves. As the patient fell asleep the respiratory rhythm became more regular, although the periodic irregularity of the amplitude of the respiratory waves was maintained (Fig. 15, b). The patient explained his condition in the following way: "I become drowsy as though I would be sinking into sleep".

During the electric sleep procedures the patient fell asleep slowly, but after 30-40 minutes he was sound asleep. During sleep (Fig. 15, c) the pneumogram again became completely rhythmical, with a regular amplitude of the respiratory excursions.

For the purpose of characterizing the data of plethysmography and the relationships of the respiratory and vascular reactions as well as the dynamics of oxyhemoglobin we are presenting several clinical observations.

Patient B., age 29, economist was in the hospital of the psychiatric institute from 9 April through 27 May 1954.

Came from a healthy family. Developed normally. Completed her primary schooling successfully, and in 1945 was accepted into a medical institute. She studied there only two semesters, then left the institute on account of disease. For the last three years she had been working at a plant as an economist. At the same time, she had been taking correspondence course at an economics-planning institute.

She denied any serious somatic diseases in her history. Menstruation began at the age of 14 and was regular; had no sexual life.

Since childhood she was reserved, egoistic and insistent.

The onset of the mental disease was referred to the year 1946. Headaches occurred, she began to make less progress in school, and she did not assimilate the school material, in connection with which she was forced to stop her studies at the medical institute. Afterwards, she became hypochondriacal and said that her "heart was torn apart," her "eyes were glassy," "a separated fetus is throwing itself about in my abdomen," which was suffocating her.

She was hospitalized in the Hospital imeni Kashchenko, where she remained from 29 June through 26 September 1946. After discharge from the hospital she worked with interruptions. She was unable to renew her studies at the institute. From 12 September through 6 December 1948 she was again on treatment in the Hospital imeni Kashchenko. She became better following insulin treatment. Beginning with 1949 she began to work at a plant, and beginning with 1951 she started her sessions in the correspondence course of the Economics Planning Institute. A subsequent deterioration in her mental condition began in the fall of 1953. At this time, the patient had worked considerably and had become overfatigued; headaches began, and afterwards "an inhibition of ideas" occurred and a paranoid disposition: everybody was looking at her, "by my eyes they recognize that I cannot cogitate about anything". She believed that her insides were changing and that her eyes "became of glass". She was confused, anxious, constantly looked at herself in the mirror, refused to eat, and did not sleep.

On 9 April 1954 she was hospitalized for the third time.

On objective examination she showed the following: the patient was infantile, and there were definite signs of an impoverishment in the state of nutrition. The tongue was dry and coated. In the lying position there was a blowing systolic murmur at the apex of the heart. The blood pressure was 100/55 millimeters of mercury.

On neurological examination exophthalmos was noted, the knee reflexes were obtainable from an extended area, there was a marked play of the blood vessels, and there was a tremor of the fingers of the outstretched hands.

Clinical analyses of the blood and urine did not show any pathological changes. The Wassermann reaction in the blood was negative.

On admission to the hospital she was confused and melancholic. She cried, "my eyes are of glass," "it is impossible to collect my thoughts," there was a "vacancy" in her head, "an emptiness," she could not read -- "the lines run together." She expressed ideas of reference: everybody was paying attention to her, speaking about her, "calling me bad;" everybody was seeing her "faults". She was unable to give any critical evaluation of her own experiences.

Treatment was given with electric sleep in combination with therapeutic doses of insulin, using 22 two-hour procedures of electric sleep and 18 insulin injections of 12 units.

The patient recovered. The delusional interpretations disappeared, and a critical evaluation of them was restored. She became able to concentrate again, active, and showed a lively interest in her surroundings. She became stronger physically. Her ability to work was recovered. She was discharged to work.

Diagnosis: schizophrenia, paranoid-hypochondriacal form.

Electric sleep treatment was carried on from 14 April through 15 May 1954.

A record of the vascular and respiratory reactions was accomplished dynamically for each electric sleep procedure, and the dynamics of the blood oxygen saturation were investigated at the same time during the process of electric sleep. At the same time, an electroencephalographic recording was taken.

We are presenting a record of the electric sleep procedure dated 11 May 1954. Before electric sleep the respiration was of irregular amplitude; the plethysmogram at the same time had a zero background with weakly expressed respiratory waves (Fig. 16, a). During deep sleep respiration remained irregular, but somewhat slowed; on the plethysmogram the picture of the respiratory waves was more distinct and third order waves were expressed which gave the plethysmogram a wave-form character (Fig. 16, b). At this time, β -rhythms appeared on the electroencephalogram.

The first oxyhemometric curve was recorded 28 April during the 12th electric sleep procedure, but without turning on the electric current. The blood oxygen saturation curve fell from 96 to 90 percent beginning with the 20th minute of sleep, and then continued to fall to 85 percent. After the 80th minute the patient began to wake up, and the oxyhemoglobin curve rose. The next day the electric sleep procedure was performed with the current turned on. This time the oxyhemoglobin curve still remained above 90 percent, despite the fact that the patient slept soundly and peacefully, as it had the evening before.

As the result of electric sleep treatment the indices of the nitrogen metabolism in the blood and urine improved in patient B. The ammonia index in the urine decreased from 6.5 to 4.0; the ratio of the amine nitrogen to the total nitrogen in the urine decreased from 12 to 3 percent. We observed a similar picture also in other patients.

Patient M, age 19, a teacher. Was in the hospital of the Institute of Psychiatry from 6 March through 6 June 1954.

Her father was sick with tuberculosis. There were no mentally ill persons among her relatives. The patient had been born prematurely, in the seventh month of pregnancy; had developed well. She had begun her studies at the age of eight, was sedulous, liked music, and she went out to the school evening parties. In her character she was sociable, gentle, good, "submissive". She had had scarlet fever, frequently suffered from influenza. She had begun menstruation at the age of 14. Her sexual life began at the age of 17 (a casual liaison).

The beginning of her mental disease pertained to the year 1953. It became difficult to study, headaches appeared with sluggishness, "apathy," at times she didn't want to do anything, and she lay in bed.

In January-February 1954 her menstruation stopped. She became worried over whether or not she was pregnant. In February 1954 she had a severe sore throat. Her sleep was disturbed, she became confused, and said that some kind of ideas were "thrusting themselves into my head," and she was unable to figure out anything -- "I am going out of my mind." She expressed snatches of delusional ideas of reference.

Objectively, there were no abnormalities in the internal organs. On neurological examinations no symptoms of organic involvement were noted in the central nervous system. Clinical analyses of blood and urine were within normal limits. The Wassermann reaction in the blood was negative.

On admission, the patient was confused, inhibited, melancholic and not very approachable. She refused to relate her pathological experiences, "I do not want to recollect". It was impossible to detect any delusional experiences in the patient. She tried to isolate herself. There was hypomania, and from time to time there was an inadequate smile

on her face. In the psychiatric department she was inactive.

Electric sleep treatment was given. During the procedures she fell asleep quickly and rapidly; after the procedures she noted a fresher alert condition. Even during the process of treatment the patient's condition improved notably. She became more collected, more adequate, and gentler. She reacted in a lively manner to visits of relatives. She began to have plans for the future. At the end of the treatment she remained somewhat asthenic, spoke reluctantly and evasively and without adequate criticism of her illness. The patient was given an additional course of treatment with hypoglycemic doses of insulin. She was transferred to the sanatorium department, from where she was discharged considerably improved.

Diagnosis: schizophrenia, simple type.

Electric sleep treatment was given from 15 March through 12 April 1954.

Before electric sleep treatment the plethysmogram was smooth, the background was zero, and there were no second- or third-order waves present. The respiration was arrhythmic (Fig. 17, a). The vascular reactions to temperature stimuli were inhibited or inverted. It was impossible to elaborate conditioned vascular reflexes or to consolidate them. During the course of falling asleep the amplitude of the pulse waves increased, respiratory waves and third-order waves appeared. The respiration became slower, and an irregular wave-form rhythm characteristic of the state of inhibition could be outlined in it (Fig. 17, b).

The following was found on the electroencephalogram before electric sleep: α -rhythm, irregular, modulated with high frequency waves. During electric sleep a general depression of electrical activity of the brain was noted, and slow waves appeared.

After several electric sleep procedures and five insulin hypoglycemic treatments the unconditioned reflexes became adequate, and conditioned vascular reflexes appeared.

On 23 March during an insulin coma an oxyhemometric curve was recorded. The curve of the blood oxygen saturation for two hours, despite the comatose condition which had occurred,

did not fall below 90-98 percent (usually during insulin coma the oxyhemometric curve falls more sharply, and the oxyhemoglobin content goes down to 70-60 percent).

Patient N, age 55, merchant; was in the hospital of the Institute of Psychiatry from 27 April through 18 June 1954.

Came from a healthy family. Developed normally, finished gymnasium [second school] successfully, after which she taught primary school for nine years. At the age of 24 she married; her family life was not successful, and she separated from her husband. She had one pregnancy which terminated in a difficult delivery. She has an adult daughter. She had typhoid fever and malaria. Beginning with 1944 she stopped menstruating. By nature she was sociable and frank.

A number of exhausting factors preceded the onset of this disease: during 1953 she had been tense, and there was a conflictual situation at work; she worked harder, and worried considerably. Psychic trauma was added to this: her daughter, in spite of her wishes, had married a man who, in the patient's opinion, "is making her daughter unhappy". She considered herself insulted by her daughter, wept considerably; her sleep was disturbed, and the feeling of helplessness and "being completely unnecessary" appeared. She could not find any place for herself, she went to her neighbors and asked what there was for her to do now. She made an attempt at suicide. She was hospitalized.

On objective examination, the patient showed pronounced signs of emaciation. Her tongue was dry and coated. There was an indistinct systolic murmur at the apex of the heart. The second sound was accentuated at the aorta. The blood pressure ranged within limits of 190/110 - 160/100 millimeters of mercury when she first came into the hospital.

On neurological examination there were no symptoms of organic involvement of the central nervous system, but disorders were noted of functional character; there was a tremor of the fingers of her outstretched hands and tick-like movements of the right corner of the mouth and of the right upper lid. The clinical analyses of the blood and urine were normal. The Wassermann test of the blood was negative.

Initially, at the time of admission to the hospital she

was melancholic, had an expression of suffering on her face, her speech was whispered, and she could not speak without crying; her thoughts were all concentrated on the experiences which had traumatized her. She was inhibited, did not socialize with those around, lay motionless with closed eyes, called herself "neglected" and "not needed by anybody".

She had difficulty in piecing together her surroundings; she understood that she was in a hospital but could not state the date on which she was hospitalized; she named the month and the year with difficulty. She asked that the physicians not interrogate her, because she was "as in a god". She asked for help: "Help me cast my unworthy daughter out of my heart". Her night's sleep was disturbed. She refused to eat; "Life has lost its meaning," there was no reason to continue it".

Electric sleep treatment was given (22 procedures) with a subsequent course of treatment with small doses of insulin. Even during the process of treatment the condition of the patient changed notably. Changes in her condition were particularly clearly manifested directly after the electric sleep procedure; she became alert, felt fresh, and asked whether she could be allowed to remain under the influence of the current for the whole day. At the end of the course of treatment the signs of confusion disappeared completely, her melancholy disappeared, her night's sleep was returned to normal, she became collected, active, and occupied herself in handiwork, she read, became compliant, welcomed socialization with the patients, was able to calm them and distract them from burdensome experiences. She became normal physically. At the time of her discharge her blood pressure was 130/70 millimeters. She was discharged to work.

Diagnosis: Reactive depression during the involutional period.

Electric sleep treatment had been given from 7 May through 5 June 1954.

On examination, the basic background of the plethysmogram was quite smooth with well-expressed second- and third-order waves. The bascular reactions, both unconditioned and conditioned, were inhibited. The respiration was uneven, arrhythmical and irregular in amplitude. During electric sleep the respiration gradually returned to normal. From

time to time during electric sleep waviness appeared in the plethysmogram. A depression of the electrical activity of the brain or the occurrence of slow waves on the electroencephalogram corresponded to these periods. The fact is particularly interesting that a decrease in the reactions to external stimuli also corresponded to this condition of an undoubted intensification of the inhibitory process. The data presented corresponded to the results of biochemical examinations.

In Fig. 18 the oxyhemometric curves are presented! On 7 May the base-line procedure was performed; a drowsy condition was observed at the end of the procedure. On 8 and 10 May there was a deep sleep under the influence of the current. The patient noted that directly after the procedure things appeared better and she was not so melancholic, but toward evening her heart again became heavy. During the first procedure, which was performed without turning on the current, she lay calmly, and fell asleep at the end of the procedure. Despite the absence of deep sleep the oxyhemoglobin content of the blood gradually fell to 84-83 percent. The next day, the current was turned on; the patient fell into a deep sleep. The oxyhemoglobin curve remained at the level of 95-93 percent for one hour and 30 minutes; the same thing was observed on subsequent days also. When conditioned-reflex sleep was administered without turning on the current following six electric sleep procedures the same high curve was obtained as on the preceding days before the current had been turned on (Fig. 18). The conclusion suggested itself that obviously a definite sleep stereotype had been elaborated in the patient, whereby the quantity of oxyhemoglobin did not fall as is usually observed during natural sleep.

The patient recovered and was sent to work in good condition.

In summarizing the clinical observations presented and comparing the clinical data with the results of pathophysiological investigations it may be established that in cases where a beneficial therapeutic effect was obtained the basic background of the plethysmogram changed -- a tendency toward normalization was noted which was expressed in the appearance of respiratory waves and third-order waves on the plethysmogram which had been inhibited prior to that. While previous to the treatment the reactions to unconditioned stimuli were absent, after the treatment adequate unconditioned

and conditioned reactions appeared. Normalization of respiration occurred for the first time only during the electric sleep procedure, and then it was maintained permanently. During the initial phases of falling asleep a waveform periodic respiratory rhythm was noted typical of conditions of hypnotic phases. A change in the blood oxygen saturation was quite typical of the condition of electric sleep: in contrast to the decreases in the oxyhemoglobin curve which are observed in pharmacological sleep the curve in electric sleep remains at a high level. Therefore, electric sleep is not accompanied by anoxia -- herein is one of the characteristics of this type of treatment compared with pharmacologic and natural sleep. As the result of treatment with electric sleep the nitrogen metabolism indices in the blood and urine were improved.

Even when the patients did not recover the tendency toward normalization of the vascular and respiratory reactions still occurred but were not maintained, and in cases where the condition deteriorated the previous pathological vascular and respiratory reactions reappeared. Similar phenomena were noted also in the dynamics of the blood oxyhemoglobin and nitrogen metabolism.

We are presenting the results of biochemical examinations carried out by E. Ye. Skuin during electric sleep treatment.

The change in the carbohydrate and protein metabolism observed during the period of electric sleep treatment both during the procedures and during the entire course of therapy did not transcend physiological limits.

The intensity of the changes in the biochemical indices were in direct proportion to the routine of electric sleep: a deeper sleep was accompanied by greater changes in the blood chemistry.

With respect to the carbohydrate metabolism an increase in the blood sugar, lactic and pyruvic acids in the blood were almost always observed during the electric sleep procedure; however, they did not transcend physiological limits. The increase in the blood sugar was temporary, and on the day following the procedure its level was always within normal limits. In certain patients a slight decrease in the blood sugar level was noted as the result of treatment given (from 85-72 milligrams percent).

With respect to the protein metabolism parallel changes were noted in the proteins and in the albumin-globulin ratio, which gives us the basis for supposing that there are changes in the colloidal state of the blood serum proteins. The strength of the blood clot underwent variations throughout the course of electric sleep treatment, chiefly decreasing during the procedure and during the course of treatment; this may be associated with a decrease in the content of adenosinetriphosphoric acid in the blood which occurs as the result of a change in the metabolism of the microergic compounds during electric sleep.

In electric sleep the content of carbonic anhydrase in the blood either increased somewhat or else did not change.

During the first few days of prolonged amytal sleep the blood carbonic anhydrase increased but did not decrease again notably on subsequent days. We are presenting the results of the observations made.

			Carbonic Anhydrase Index	
Patient P.	3 May	before sleep.....	2.0	0.9
	13 May	during electric sleep.....	2.9	1.3
	20 May	before electric sleep.....	2.0	1.0
	20 May	during electric sleep.....	2.4	1.2
Patient K	15 January	before sleep produced by amytal.....	2.5	1.3
	29 January	-third day of sleep.....	2.2	1.0
	30 February	-eighth day of sleep...	1.4	0.6

Changes in the carbonic anhydrase activity may be explained by the slight degree of anoxia which occurs during the first few days and which is replaced by a deep-seated disturbance in the oxidative processes on subsequent days of amytal sleep expressed to varying degrees in different patients. In electric sleep we did not observe any decrease in the carbonic anhydrase activity; its change in the direction of an increase can be interpreted as the result of an intensification of the oxygen consumption by the tissues, particularly by the brain.

Changes in the carbonic anhydrase activity in the blood speak for the greater disturbances in the oxidative proces-

ses in prolonged amytal sleep compared with electric sleep, particularly during the final days of treatment.

During the electric sleep procedure changes were observed in the distribution of the phosphate fractions in the blood (observations of O. R. Shishova from our laboratory) as well as in the indices of the carbohydrate and protein metabolism. A slight increase in the sugar level was observed with a simultaneous reduction in reducing agents, which was expressed in a difference between the sugar determined by the Hagedorn method and the true sugar (according to the Fujita and Takata method). Thus, for example, in patient A before sleep the sugar was 58 milligrams percent; the reducing agents amounted to 32 milligrams percent; after a two-hour sleep the sugar was 64 milligrams percent and the reducing agents, 18 milligrams percent.

In parallel with the reduction in reducing agents there was also a decrease in the inorganic phosphorus, which was most strikingly expressed in patients with schizophrenia (in patient B before sleep the inorganic phosphorus was six milligrams percent; after the procedure, 4.3 milligrams percent).

With respect to the distribution of phosphate fractions in the blood during the procedure of electric sleep a decrease was noted in the concentration of adenosinetriphosphoric acid and the inorganic and acid-soluble phosphorus with an increase in the protein-lipoid fraction of the phosphorus.

As the result of the treatment, as a rule, an increase was noted in the total phosphorus as well as in the relationship between the protein-lipoid and the acid-soluble phosphorus and a decrease in the acid-soluble phosphorus because of a decrease in the inorganic phosphorus and phosphoric ethers. Thus, for example, in patient A the total phosphorus before treatment amounted to 59.5 milligrams percent; after treatment, 91.5 milligrams percent. The protein-lipoid fraction in patient M before the procedure was 33 milligrams percent; after a two-hour sleep, 53 milligrams percent; as the result of the treatment, 68 milligrams percent, et cetera. In patient A the inorganic phosphorus before treatment was nine milligrams percent; the phosphoric ethers was 21.6 milligrams percent; after treatment, 5.3 and 9.5 milligrams percent respectively.

The changes indicated in the carbohydrate metabolism and in the phosphate fractions speak for the fact that when there is a beneficial clinical effect under the influence of electric sleep the processes of carbohydrate metabolism become normal through the medium of a greater intensity of the intermediate enzymatic processes (glycolysis, phosphorylation).

The changes in the nitrogen metabolism amounted to a decrease in the total quantity of serum protein and a reduction in the albumin-globulin ratio during the electric sleep procedure. When there was a poor clinical effect the quantity of protein did not decrease but as a matter of fact even increased. When there was a good clinical effect the quantity of albumin, like the albumin-globulin ratio, increased. During the electric sleep procedure a certain reduction in the amine nitrogen was observed (in patient M it decreased from 11.2 to 8.4 milligrams percent).

It was possible to confirm the changes in the concentration of free amines (histamine) and of amino acids in the blood under the influence of electric sleep therapy by the chromatographic method.

Therefore, these investigations show that the effect of a pulsating current exerts a beneficial influence even on certain mechanisms of the vegetative nervous system regulation. To this it may be added that, despite the additional hours of sleep obtained during the daytime, the night's sleep was thereby not only not disturbed but, conversely, became normal (if it had been disturbed -- insomnia). This normalizing effect on the night's sleep is a characteristic consequence of a pulsating current.

3. Investigation of the Depth of Sleep During Electric Sleep

For the purpose of determining the depth of sleep in electric sleep we made use of the method of comparative study of the dynamics of conditioned and unconditioned reflexes, somewhat altering the methods of L. I. Kotlyarevskiy which he used in 1936 in the study of the depth of sleep in children.

L. I. Kotlyarevskiy investigated the change in the conditioned reflex to a bell during sleep which was elaborated

preliminarily with speech reinforcement. As the unconditioned reflex the plantar reflex was investigated, as was also the defensive oculo-facial reflex (screwing up the eyes, and turning the head to the side) when a stream of air from a balloon was directed into the face.

Prior to sleep a check was made of the unconditioned reflex, the conditioned reflex three times, and differentiation once. A toy balloon was attached to the hand, and then, every 15 minutes, the conditioned and unconditioned stimuli were administered periodically, and the character of the response was observed.

The author established three characteristic phases: in the first phase the conditioned and unconditioned reflexes were maintained; in the second, the conditioned reflex was absent and the unconditioned reflexes were absent. Thereby, sleep in children has the following character: a) all three phases occur, but the first and second disappear rapidly, that is, inhibition irradiates quickly, descending to the subcortex; in awakening such sleep disappears immediately, and the child feels alert; b) only the first and second phases occur, whereby the first is brief; inhibition irradiates rapidly through the cortex but practically does not descend to the subcortex; in the process of waking up the sleep disappears slowly and gradually; c) only the first and second phases occur also but the first goes on for a long time and the conditioned reflex thereby is unstable; the irradiation of inhibition can occur only through the cortex and occurs in a wave form; waking occurs slowly and with great difficulty.

In our method an investigation was made of the motor-defensive reaction to electrocutaneous stimulations, which served as a reinforcement in the process of elaborating the conditioned reaction to sound stimuli (bells of different strength and timbre). V. M. Bekhterev, V. P. Protopopov, A. G. Ivanov-Smolenskiy and others used electrocutaneous reinforcement.

In the investigation of the depth of sleep it was undesirable to trouble the subject with the need for maintaining a fixed position connected with the usual method of carrying out the investigations of electrocutaneous stimulation. In connection with this, we worked out a special adaptation which is fastened to the fingers and which makes it possible to carry out the examination with the hands in any position.

This adaptation (Fig. 19, a) consists of a shaped plexiglass brace (1) which, by means of a detachable portion (2), is attached with a small strap to the basal phalanges of the second to fourth digits and which embraces the latter, as is shown in Fig. 19, b. Because of the detachable portion the brace can be adapted to the length of the fingers of the subject. Contacts (3), to which the voltage from an induction coil is brought through a switch and a control potentiometer, are placed in the upper portion of the brace (corresponding to the location of the proximal portion of the distal phalanges). Contacts (4-5) are placed in the lower portion of the brace which are closed through flexion of the fingers. One of the contacts (4) is stationary having a device regulating its height; the second (5) is a spring contact and appresses the fingers to the contacts, to which the electrical stimulation is administered.

When the pushbutton circuit of the induction coil is switched on under the influence of the painful electrical stimulation an unconditioned motor-defensive reaction occurs in the form of flexion of the fingers. This movement closes the lower contacts, which produce a flash of the signal lamp or a record on the strip (if the recording is by kymograph). The position of the fingers is shown in Fig. 19a. When the fingers are touching the contacts through which the electrical stimulation is applied the spring returns them to their initial position. Such an arrangement makes it possible to carry out the investigation under any conditions and even at the patient's bedside.

In patients in whom this examination was carried out the conditioned reflex -- flexion of the fingers in response to a bell of moderate amplitude with reinforcement by an unconditioned stimulus, an induction current -- was elaborated before beginning the course of electric sleep. In certain patients differentiation from the bell of a different tone was also elaborated. The strength of the conditioned reflex and differentiation were checked before each investigation.

The investigation was carried out during electric sleep: at definite intervals (usually at 15 minutes) a conditioned stimulus (bell) was administered, and observation was made as to whether or not the conditioned reflex appeared, and if it appeared, after what latent period. The results of the investigation were recorded on the kymograph.

If the conditioned reflex occurred after a usual latent period and after a relatively brief (one to two seconds) effect of the conditioned stimulus the conclusion could be drawn that no particular change in the subject's condition had occurred.

In the event the conditioned reflex occurred after a prolonged latent period or only in response to a prolonged (three to five seconds) effect of the conditioned stimulus it could be considered that a gradual irradiation of inhibition was occurring throughout the cerebral cortex.

Finally, in the event the conditioned reflex did not occur after a prolonged and repeated effect of the conditioned stimulus the conclusion could be drawn that inhibition had irradiated throughout the cerebral cortex, had included the area of the sound analyzer, and was quite intense in these areas, which served as an objective indication of the advent of sleep in the subjects.

Under the conditions of irradiation of inhibition throughout the cerebral cortex but without any intensification of it in the subcortical-brain-stem centers the reaction to unconditioned stimulation should be maintained (in our case, to the electric current from the induction coil), which can also be observed under appropriate conditions. The absence of a reaction to unconditioned stimulation may constitute evidence of a deep-seated inhibition which not only has irradiated throughout the cerebral cortex but which also has become intense in the subcortical-brain stem centers.

For the purpose of demonstrating hypnotic phases we used bells of different strengths (louder and quieter) as well as a buzzer for the purpose of differentiation. A defect in our method was the fact that we could not take the strength of the reaction into consideration but merely noted its presence or absence. This effect was compensated for by the fact that the subject's hands were free, not interfering with them during sleep.

Simultaneous with the investigation of the dynamics of the conditioned and unconditioned reflexes we made a record of the action currents of the brain.

After establishing the nature of the electroencephalogram before sleep we took a second record of the action currents during the period when the existence of diffuse inhibition

had been established in the cerebral cortex. For this purpose the record of the action currents was taken only after the absence of any reaction to the conditioned stimulus had been established, which was checked repeatedly after taking a record of the action currents.

We are presenting the results of our observations.

Patient A., age 20, student. Had been in the hospital of the Institute from 16 April through 20 June 1953.

Diagnosis: schizophrenia, simple type.

She was admitted with complaints of headache and of being unable to continue her studies.

She came from a healthy family. She grew up a healthy child. Beginning with the age of eight she began to go to school. The first seven years in school she was excellent in her studies. Beginning with the eighth grade she began to drop back in her studies; however, she completed her 10 years of school and entered the Pedagogical Institute.

By nature she was cheerful, happy, and had many friends. She denied any serious somatic illnesses and head trauma in her history. Menstruation began at the age of 17 and was irregular. The patient had been sick for more than four years. During this period, her nature changed -- she became sluggish, reserved; her progress in schoolwork decreased; she constantly complained of headaches.

For the six months prior to admission the patient's condition had deteriorated in particularly notable fashion; she could not pass her winter session examinations, and left the institute. She became melancholic, refused to leave the house, and told her mother that "she was ashamed to show herself to people".

There were no abnormalities in the internal organs or in the nervous system.

She spoke in a quiet monotonous voice and did not look at the person with whom she was speaking. She stated that everyone had changed their attitudes toward her, and she began to avoid her friends. She complained of constant headaches and of an absence of ideas. She considered herself seriously sick and said that a "pathological associ-

ation had been formed in her head which had to be broken". She spoke about all this in a subdued indifferent tone of voice. She did not show any hallucinatory disorders.

On 20 April 1953 electric sleep treatment was begun. On 21 April a conditioned reflex was elaborated to a positive stimulus -- a bell of moderate strength with reinforcement by a current from an induction coil. The conditioned reaction appeared in the fifth combination, was consolidated after 26 combinations. Generalization was noted of the conditioned reaction in the auditory analyzer. No differentiation was made between the loud bell and the bell of moderate strength or from another tone. The reaction was noted to all bells without distinction.

After elaboration of the conditioned motor-defensive reaction the orientative (so-called "base-line") procedure of electric sleep lasting 30 minutes was checked.

After turning on the current the patient lay peacefully and without movement. Respiration was regular, particularly initially after turning on the current, which created the outward picture of drowsiness and even of sleep. However, the conditioned stimulus produced a conditioned reflex without any abnormalities 15 and 30 minutes after the current was switched on. Therefore, no change in the patient's condition was determined objectively.

On 23 April the first electric sleep procedure (duration one hour) was carried out. The conditioned reflex was checked before the procedure (Fig. 20). At first, the bell had to be reinforced by the unconditioned stimulus; then, it was consolidated. Differentiation was not successful; the patient showed the conditioned reaction to all bells without distinction (Fig. 20, a).

Immediately after turning on the pulsating current the respiration assumed a regular character (number of respirations, 20 a minute). The patient lay in a calm relaxed position. According to her external appearance she was drowsy. For the examination of the conditioned reactions see Fig. 20, b.

The positive conditioned stimulus administered 15 minutes after the current was turned on -- a bell of moderate strength -- did not produce any conditioned reaction; a subsequent loud bell produced it. In this case, we can

speak of an intermediate phase of sleep, where the stimulus of moderate strength did not produce the reflex, and where the stimulus of considerable strength did produce it.

In the next observation (30 minutes after turning on the pulsating current) the following was noted: the patient was immobile, lay in a relaxed position. The respiration was even, deep, slow (17 a minute). According to her external appearance, she was asleep. The conditioned reaction to the bell of moderate strength and to the loud bell was absent.

The next observation was made 45 minutes after the pulsating current had been turned on. The external appearance of the patient had not changed. Respiration was 16 per minute.

The conditioned reaction was absent both to the bell of moderate strength and to the loud bell.

A second conditioned stimulus -- a bell of moderate strength -- did not produce any conditioned reflex either; however, the patient took a deep breath and turned on the opposite side, that is, the stimulation disturbed the depth of sleep. Actually, the repeated conditioned stimulus did produce a reflex; however, it had a prolonged latent period and was associated with a double flexion of the fingers; the flexion was repeated after several seconds.

The last observation was made at the end of the procedure, one hour after switching on the pulsating current. The patient was calm; however, according to her external appearance sleep was not deep. Respiration was regular but was not slow (20 a minute). The conditioned stimulus (both the bell of moderate strength and the loud bell) produced a reaction. The pulsating current was switched off, and the electrodes were removed. The patient was not asleep. In response to the question "Were you sleeping, and why did you wake up?" she answered: "I think I was sleeping, and then I woke up; I do not know why."

The establishment of sleep inhibition may be studied on the basis of the picture of the course of the conditioned reactions: the first observation (15 minutes) indicated a transitional phasic state; the second (30 minutes), diffuse inhibition of the cerebral cortex and quite deep sleep; the third (45 minutes), a similar condition with, however, more

superficial sleep under the conditions of which the repeated effect of the conditioned stimulus disturbed the diffuse inhibition and actually "awoke" the patient, which was also expressed in a return of the conditioned reflex at the time of the fourth observation.

A picture similar to this one was noted at the time of the next electric sleep procedure 25 May (lasting $1\frac{1}{2}$ hours).

The observations were made after 30 minutes. At the time of the first observation (30 minutes) after beginning the procedure the patient was somewhat restless; her respiration was regular (18-20 per minute). The external picture was that of drowsiness. The conditioned stimulus produced a reflex.

At the time of the second observation (an hour after beginning the procedure) the patient was immobile and in a calm relaxed position. The respiration was even, deep (18 a minute). The external picture was that of sleep. There was no conditioned reflex, even after prolonged and repeated stimulation (bell of moderate loudness). However, the recording of the cerebral action currents at this time somewhat disturbed the depth of sleep (accidental noise); the patient moved restlessly, and the regularity of respiration was disturbed. In order to avoid disturbing her sleep the conditioned reflex was not checked; the patient gradually quieted down, and the picture of sleep was resumed. However, the conditioned stimulus administered after 15 minutes produced a reflex; however, the latent period was prolonged to four seconds.

The last observation was made an hour and 15 minutes after the beginning of the procedure; the conditioned reflex now was produced without any prolongation of the latent period.

In this patient the existence of diffuse cortical inhibition was established only at the time of the second observation (an hour after beginning the electric sleep); afterwards, only a condition of transitional character could be noted.

The electroencephalographic data were as follows: a) record before onset of electric sleep. In the occipital areas of both sides there were α -waves with a frequency of 10 per

second and an amplitude of 30-40 microvolts occurring in distinct regular groups.

In the frontal areas the curve consisted of asynchronous waves of different frequencies (30-60 a second) and an irregular shape with an amplitude of up to 20 microvolts.

b) Record after one hour of electric sleep. In the occipital areas the curve had a similar character; however, the amplitude of the α -waves did not exceed 15-20 microvolts on the left and 20-25 microvolts on the right; the modulation of the waves was less noticeable. In the frontal areas, little electrical activity was noted and the curve consisted of irregular waves, chiefly with slow rhythms (of α -waves and less) of small amplitude.

c) Record after the termination of electric sleep. In the frontal areas on the left the curve was similar to the preceding (electrical activity decrease); on the right, the curve assumed a character similar to the initial one. In the frontal areas, the curve was similar to the preceding; however, the amplitude of the waves increased to 15-20 microvolts, corresponding to which high-frequency waves, which constituted it, began to be noted.

On 28 May (fourth electric sleep procedure, Fig. 21). Before administering the electric sleep the conditioned reflex and differentiation were checked. An electroencephalographic record was taken (No 4).

Thirty minutes after beginning the electric sleep procedure the patient was sleeping quite deeply. The conditioned positive and differentiating stimuli did not produce any reflex. A record of the action currents was made (No 65), after which the depth of sleep was checked: the reflex was absent both to the positive and differentiating stimulus.

An hour after the beginning of the electric sleep procedure the patient was sleeping; an electroencephalogram was made (No 66). There was no conditioned reflex.

An hour and a half after the beginning of the electric sleep procedure there was a similar picture. The action currents were recorded (No 67). The conditioned reflex was absent before recording the action currents and after it. The patient was awakened. An electroencephalographic record

was taken. The conditioned reflex was adequate and differentiation was preserved.

Electroencephalographic data (Fig. 22):

a) Record before the beginning of the electric sleep procedure (No 64). In the occipital area there are quite regular α -waves with a frequency of 10 a second and an amplitude of 30-40 microvolts with high-frequency waves of hardly noticeable amplitude imposed on them on the right; on the left, the waves have an amplitude of less than 10 microvolts.

In the frontal area on the right there are individual groups of α -waves with an amplitude of up to 20 microvolts; on both sides, there are high frequency waves (40-60 per second) of irregular character with an amplitude on the right of up to 10 microvolts and on the left, up to 30-40 microvolts.

b) Record taken 30 minutes after beginning electric sleep (No 65). In the occipital areas on both sides there are α -waves with a frequency of 10 per second modulated in regular groups, with an amplitude on the right of up to 30 microvolts, and on the left, up to 50 microvolts; on the left, in places, the waves are of insignificant amplitude. In the frontal areas on the right there are quite regular α -waves with amplitudes of up to 20 microvolts; on the left, there are individual groups of α -waves of insignificant amplitude but chiefly high-frequency waves of irregular character with an amplitude of 10-15 microvolts.

c) Record after an hour of electric sleep (No 66). Occipital leads: a picture similar to the preceding, but the α -waves are modulated into rarer groups. In the frontal areas the picture is similar to the preceding.

d) Record taken 1 $\frac{1}{2}$ hours after the beginning of electric sleep (No 67). In the occipital leads the α -waves on both sides are now found only in quite rare groups (considerable reduction of electrical activity). In the frontal areas the picture shows no particular changes.

e) After electric sleep (immediately after turning off the current) (No 68). A picture similar to the initial, with the exception of the fact that the high-frequency waves in the frontal areas are of a somewhat lower amplitude, par-

ticularly on the left, less than 20 microvolts.

A similar picture was repeated in subsequent procedures: 15-20 minutes after turning on the pulsating current the patient fell asleep quite deeply. Objectively, this was expressed in a complete absence of the conditioned reaction both to the moderately loud and the loud bells.

We shall not discuss the remaining observations.

In summarizing the observations made on the patients during electric sleep it may be pointed out that we encountered the following changes in the conditioned reaction: prolongation of the latent period, inconstancy of the reflex in response to successive stimuli, the appearance of the reflex only in response to a repeated and more prolonged stimulus (narcotic phase), occurrence of the reflex only in response to a quieter and shorter-lasting bell (paradoxical reaction), positive reaction to the differentiating stimulus (ultraparadoxical phase), and, finally, complete absence of the reflex in response to the repeated and prolonged effect of the conditioned stimulus (inhibitory phase).

All these phenomena are to be explained through the process of irradiation of inhibition produced by the effect of the pulsating current through the cerebral cortex. In the last case, with complete absence of the conditioned reflex, the existence may be supposed of a diffuse inhibition in the cerebral cortex which includes the area of the auditory analyzer, which outwardly is manifested in quite deep sleep.

With respect to the unconditioned reflex it may be pointed out that in the majority of our observations it occurred, whereby the effect of the electrical stimulus produced an inadequately strong motor reaction and disturbed sleep. This gives us reason to believe that in these cases the diffuse inhibition was limited to the cerebral cortex; the subcortical centers possibly were even in a state of increased tone. In rarer cases, the unconditioned reaction was absent, which speaks for irradiation of inhibition also to subcortical centers (clinically, deep sleep).

In systematizing these data four principal phases of electric sleep may be established characterized by different degrees of distribution and depth of inhibition produced by the effect of the pulsating current.

First phase -- the conditioned reflex is obtained consistently and without any notable change in the latent period or strength relationships. Differentiation is maintained, that is, there are no objective data attesting to the presence or irradiation of an inhibitory process throughout the cerebral cortex. According to the clinical picture, this corresponds to cases "without any visible change in condition".

Second phase -- the conditioned reflex is inconstant, appears after a prolonged latent period or after the prolonged effect of the conditioned stimulus; differentiation is disturbed, and disturbances in the strength relationships become prominent. In this case, a partial (gradual) irradiation of inhibition throughout the cerebral cortex may be supposed with the manifestation of hypnotic phases. Clinically, the state of drowsiness passing into superficial sleep corresponds to this.

Third phase -- the conditioned reflex is consistently absent, but the unconditioned reflex is maintained, that is, a considerable irradiation of inhibition throughout the cerebral cortex occurs which embraces the area of the auditory analyzer. Clinically, this corresponds to the state of quite deep sleep.

Fourth phase (observed in only two subjects) -- not only the conditioned but also the unconditioned reflex is absent; inhibition not only includes the cerebral cortex but to some degree also is deepened to include the subcortical-brain stem centers; clinically, the state of deep sleep corresponds to this.

The phases mentioned are usually established in sequence, replacing one another. In the majority of patients these shifts stop in the second and third phases. Less often, the fourth phase of deep sleep is observed also with the absence of the unconditioned reflex.

Therefore, our observations show how an inhibitory process occurs under the influence of a pulsating current and how it gradually irradiates including the cerebral cortex and sometimes also the subcortical centers, which is manifested outwardly, first, in transitional states of the nature of drowsiness, which subsequently change into sleep of varying depths. The sleep may continue unchanged even after the current is turned off, which also speaks for its

similarity to physiological sleep. The effect of the pulsating current is the trigger mechanism of sleep.

The degree and depth of irradiation of inhibition which determine the difference in the conditions produced by the effect of the pulsating current may depend on many factors. Without considering the significance of the environmental circumstances (exclusion of external stimuli), it depends to a considerable degree on the functional state of the central nervous system at the time of the effect, which has a dynamic nature even in the same patients.

This difference in conditions should depend on the capacity of nerve cells to develop an inhibitory process in them and on the irradiation of it to neighboring areas, which is associated with the type of nervous system of the patients. I. P. Pavlov writes, "The type with the predominance of the stimulatory process has a great tendency to go asleep under the conditions of our experiments, while the readily inhibited type, on the other hand, remains awake under the same conditions". (I. P. Pavlov. Collection of Works. 1947, Vol IV, p 240). Aside from the effect of the pulsating current the exclusion of the visual receptor through the application of the ocular electrode, quiet, comfortable position, et cetera, also contribute to the development of sleep inhibition in electric sleep. In the subsequent pulsating current procedures the conditioned reflex mechanism of production of sleep also undoubtedly participates.

It seems to us that the data presented permit us to believe, with an adequate degree of probability, that under the influence of the pulsating current it is not some kind of special pathological condition approaching electronarcosis which is produced but rather a natural sleep of different depths, beginning with transitional phasic states and ending with full and deep sleep. The effect of the pulsating current is a trigger mechanism of this sleep, which, once it has occurred continues according to its own natural laws regardless of the continuance or cessation of the effect of the current.

The study of the electrical activity of the brain in electric sleep shows that in electric sleep the following characteristic changes may be noted in the electrical activity. Under conditions where drowsiness rather than particularly deep sleep is produced from the effect of the pulsating

current a depression of the α -rhythm and a decrease of electrical activity and the occurrence of slow waves, et cetera, were noted on the electroencephalogram taken after the pulsating current was turned off.

In these investigations the nature of the patient's condition (drowsiness, sleep) was determined according to the clinical picture. In the present investigation we studied the change in electrical activity of the brain in electric sleep, checking on the nature of the patient's condition by the objective method. We recorded the action currents during the periods of sleep, wherein the objective nature of the patient's condition was established (before and after recording the action currents) by means of an investigation of the dynamics of the conditioned reflex.

An analysis of the data obtained shows that the depression in the α -waves noted above and the reduction in electrical activity correspond to the period of persistent absence of the conditioned reflex, that is, to the period of diffuse inhibition of the cerebral cortex.

The change in electrical activity mentioned occurs gradually, in proportion to the duration of the given period. These data coincide with our observations made previously. Once again they confirm the natural character of sleep produced by the effect of the pulsating current.

Therefore, our investigations show that both in the clinical picture and according to the data of certain objective examinations electric sleep represents actually physiological sleep which has been produced by the effect of the pulsating current. The latter acts as a rhythmical monotonous stimulus under the influence of which the nerve cell, in I. P. Pavlov's expression "Inevitably passes into an inhibitory state".

At the same time, certain characteristics of electric sleep should be noted which show that the effect of the pulsating current, particularly in an organism in which the regulation has been disturbed, is considerably more complex than simple rhythmical stimuli of the nature of the blinking of a lamp or rhythmical swinging, which under certain conditions also produce sleep.

Observations in the hospital show, for example, that the therapeutic effect of electric sleep is not directly related

to the depth and duration of sleep during the procedure. The normalization of the disturbed night's sleep is observed also when the patients have not entirely fallen asleep during the procedure.

Normalization of the pneumogram and plethysmogram in patients with schizophrenia through the effect of the pulsating current occurred even before the advent of drowsiness or sleep.

Even after a relatively brief superficial sleep during the procedure the patients feel a particular freshness and alertness (as after a deep night's sleep).

All this shows that deeper-seated functional reorganizations are produced in the bodies of patients through the effect of the pulsating current than those which may be achieved by several additional hours of sleep produced by indifferent rhythmical stimuli.

The biochemical changes investigated by E. Ya. Skuin' in the metabolism of patients treated with electric sleep are also more considerable than those which might be expected from the effect of several additional hours of sleep.

All this causes us to express the supposition that the effect of the electric current on nerve centers is of importance in the therapeutic effect of electric sleep. It may be supposed that specifically the condition of superficial sleep, where a diffuse cerebral cortical inhibition occurs without spread of it to subcortical-brain stem centers, gives the best therapeutic effect.

Apparently in this case, the subcortical-brain stem centers which are subjected to the most intense effect of the current (ocular-occipital arrangement of the electrodes), may be in a condition of a somewhat increased tone (which increases the cerebral cortical inhibition according to the law of induction), which contributes to an improvement in the trophic and regulatory function of the nerve centers.

Our supposition was proved in the experimental investigations of I. S. Robiner on animals, the results of which are presented below.

4. The Problem of the Direct Effect of a Pulsating Current on the Central Nervous System

The direct effect of a pulsating current on the central nervous system as a weak rhythmic stimulus underlies the electric sleep method. The mechanism of action of the pulsating current on the central nervous system seems to be very complex, including both the direct effect of the current on the cerebral centers and its effect on the peripheral receptors and conducting tracts of the central nervous system.

The problem of the central or peripheral effect of the pulsating current is not only of theoretical but also of practical significance. If we consider, as certain authors (for example, G. Yu. Belitskiy) do, that only stimulation of the nerve receptors of the skin is important in electric sleep, then the methods may be simplified considerably and reduced to stimulation of the skin with a weak induction current, as has been done, for example, in the experiments of M. N. Yerofeyeva.

Control observations made by us in people showed that the weak electrical stimulation of the skin gives the effect of producing sleep in approximately the same way as does the effect of other monotonous weak external stimuli (for example, the blinking of a lamp, the beat of a metronome, swinging, et cetera). However, this effect is varying, indefinite, and inconstant, and, principally, it does not produce any beneficial clinical effect.

A comparison of these observations with the definite, consistent, and, principally, clinically effective electric sleep according to our method gives us the basis for the belief that in electric sleep a direct effect of the pulsating current on the brain is also of importance. In this connection, the method of using the pulsating current in electric sleep is similar to the "transcerebral galvanization" (according to the Bourguignon method) which has been widely used in physiotherapy and is designed to produce an effect of the current on the nerve centers of the brain. In electric sleep it is not a direct current effect which is used but rather a pulsating low frequency current, thanks to which a different effect is obtained than after transcerebral galvanization.

For the purpose of solving the problem of the mechanism

of action of the electric current on the brain it is essential primarily to establish experimentally by which routes and to what degree the current passes into the brain mass with the external (on the skin) arrangement of the electrodes, and, therefore, with what intensity it can act on the various brain centers.

For the purpose of clarifying this problem V. A. Glazov performed a special experiment. By means of a probe made of two insulated needles connected with a galvanometer the relative current density was determined at various points in the brain of a rabbit during the effect of an interrupted direct current (according to the electronarcosis method) with electrodes arranged fronto-lumbarly. The results of the measurements showed that the current density in the brain centers at the base of the skull is much greater than in the brain centers next to the skull vault.

In analyzing the conditions of passage of the current into the cranial cavity from a physical point of view, we may consider, taking into consideration the great resistance of the solid bone tissue, that the current must pass into the skull and leave it through the natural openings in the bones and also through the very thin sections of cellular bone covered with mucous membrane. The brain tissue, which is similar to fatty tissue in its electrical properties, also possesses quite a high degree of electrical resistance. Therefore, the distribution of the lines of force of the current occurs irregularly within the brain mass, and the current spreads chiefly along the course of the blood vessels as well as along the spaces and fissures filled with spinal fluid.

Keeping in mind the structure of the skull (the existence of a large number of openings for the vasoneural trunks, as well as the presence of cellular bone in the orbits and base of the skull) there is every reason to believe that the current enters the skull and leaves it chiefly at the base. The current density in the brain centers at the base of the skull, where main nutrient arteries (circle of Willis) and spinal-fluid-filled spaces (cisterns) are also located, will be greater than in the centers next to the skull vault. This has been confirmed by V. A. Glazov experimentally. In connection with this, we consider the ocular-occipital arrangement of the electrodes most advantageous for the effect of the current on the brain.

Thereby, the current enters the skull principally through the fissures and openings in the walls and base of the orbits and leaves through the foramen magnum, the emissaries and cellular bone of the mastoid processes. Thereby, the current acts also on the receptor apparatus of structures in the orbits and also those of soft tissues surrounding the skull. We do not deny the presence of a reflex component in the reactions to the effect of a pulsating current with an ocular-occipital arrangement of the electrodes, but the entire physiological mechanism of these reactions is not limited to this.

Nevertheless, in connection with the great significance of this fact it was decided to repeat the experiments performed by V. A. Glazov under conditions of action of a current in electric sleep, that is, with an ocular-occipital arrangement of the electrodes and the effect of a pulsating current with the characteristics which we have selected.

A probe was made consisting of two needles silvered at their ends and covered throughout (except for the ends) with an insulating enamel lac and fastened in a frame which makes it possible to advance the ends of the needles for a definite distance, which can be measured by a scale present on the frame. The needles are arranged in parallel and at a distance of three millimeters from one another, and are connected with a mirror galvanometer by soft wires.

A round hole five millimeters in diameter was first trephined in the vault of a rabbit's skull. The experiment was performed after the skin sutures had healed.

The measurements were made by means of a mirror galvanometer with a sensitivity of $1^\circ = 1.7 \times 10^{-9}$ amperes.

By means of the mirror galvanometer and using a pulsating current it was possible to establish the presence of current in the brain mass. However, it was difficult to make finer measurements dealing with the distribution of the current, because the mirror galvanometer has too much inertia for such brief impulses. The current distribution was studied for the effect of a galvanic current (four ma strength) with an ocular-occipital arrangement of the electrodes.

A total of eight experiments on four rabbits were performed. It should be noted that the study of the distribu-

tion of the current in "the depth" of the brain mass is complicated by the irregular distribution of the current not only in the vertical but also in the horizontal direction; therefore, the magnitude of the deflections of the galvanometer observed depends not only the depth of submersion of the probe but also on its direction with respect to the sagittal plane. With the gradual advancement of the probe through the intact skin and the trephined opening in the skull vault and into the depth of the brain mass to the base of the skull two current density maxima are observed: one, directly under the skin; the other, in the vicinity of the base of the skull.

After analyzing the data obtained it may be considered that the first maximum of current density directly under the skin is associated with the current which is distributed in the subcutaneous tissue and also along the surface of the dura mater. Because of the presence of a trephined opening at this spot the current routes mentioned run together. Then, the current density decreases sharply and remains at low figures down to a considerable depth, where the second current density maximum is observed corresponding to the location of the brain centers next to the base of the skull.

Therefore, our measurements, first of all, very definitely establish the penetration of both a pulsating and continuous galvanic current into the brain mass when an ocular-occipital arrangement of the electrodes is used, and, secondly, confirmed V. A. Glazov's statements that where an external arrangement of the electrodes is used the current density in the brain centers lying at the base is the greatest, and it decreases in a direction toward the centers lying next to the skull vault.

After initially adopting the usual ocular-occipital arrangement of the electrodes in man, we became convinced during the process of work that unpleasant sensations frequently occur in the bones of the facial skeleton with such an arrangement of the electrodes and from the action of a pulsating current, whereby their intensity depends on the site of location of the posterior electrode: the lower it is placed in the occipital area the more intense these sensations are. Where it is possible (no hair) to arrange the electrodes higher in the occipital area these sensations disappear. This constitutes evidence to the effect that the arrangement of the occipital electrode influences the distribution of the lines of force in the tissue surround-

ing the skull, and that a low position of the electrode leads to the branching off of a larger portion of the current in the area of the face and to the occurrence of unpleasant sensations.

In accordance with these observations we used an electrode of special construction in our first experiments; this made it possible to place it on the hairy portion of the head directly in the occipital area. It consisted of a multitude of movable rods penetrating between the hairs like the teeth of a comb. The use of such an electrode reduces the intensity of the unpleasant sensations and makes it possible to increase the threshold dosage of the current; the sensation from the passage of the current is localized now only in the depth of the orbit. The experience in this work later showed that the comb electrode can be replaced by a split-plate electrode of small area which is applied behind the ear conchae directly over the mastoid processes. In these places the skin is usually without hair, and in an extreme case the latter can be shaved off somewhat.

Through the experiments described above only the fact of the passage of the current inside the skull was established and the most effective arrangement of the electrodes found (orbit-mastoid processes).

I. S. Robiner carried out a special investigation which made it possible to establish the finer proofs on behalf of our concept that the direct effect of the current on the brain centers is also of definite importance in electric sleep. The investigation consists of two parts: clinical and experimental. By the electroencephalographic method a study was made in both parts of the investigation of the so-called "spontaneous" electrical activity of the brain under the condition of action of a pulsating current according to the electric sleep method.

In the clinical portion of the investigation electric sleep was administered to healthy persons and patients suffering from insomnia and who were in reactive and asthenic states. Thereby, a neurological examination was made, and the reactivity curves were also investigated, and conditioned reflexes to sound stimuli were also elaborated according to the speech-motor methods of A. G. Ivanov-Smolenskiy: the prolonged ringing of a bell served as the positive signal; an interrupted bell, the negative. After that,

the electric sleep procedure was performed on the subject lasting up to two hours, and this was continued over a period of 20 days.

For the purpose of studying the effect of a pulsating current on the subcortical brain centers experiments were performed on rabbits under conditions of a chronic experiment with the implantation of electrodes into the cerebral cortex and thalamus. Before beginning each electric sleep procedure a bipolar control electroencephalographic record in the fronto-temporal and parieto-occipital leads was made on a double-channel cathode-ray oscillograph. Bipolar recordings were made of the cortical action currents (electrocorticograms) and the action currents of the thalamus (electrothalamograms) in the rabbits. Then, the pulsating current was turned on (rectangular impulses of constant polarity with an impulse duration of 0.2-0.3 meter/second), and was turned on every 10-15 minutes for one minute; at this time, electroencephalograms were taken, and the state of the conditioned reflex activity was investigated.

A total of 197 electric sleep procedures were performed in the hospital, and 132 procedures in experiments on six rabbits. Electroencephalograms were taken at the end of all 20 procedures daily for three to four weeks in people and animals.

The frequency of the pulsating current used was different: 6, 10, 12 and 18 impulses per second. The arrangement of the electrodes in man was ocular-occipital (on the mastoid processes) [actually, the word translated "ocular" here means "orbital"]. In the animals the electrodes were arranged either directly on the skin of the head or the current was hooked up to electrodes implanted in a skull bone deprived of periosteum or to electrodes implanted directly in the thalamus. Usually, electric sleep was administered using a single pulsating current frequency, for example, six, for the same rabbit, and after four or five months the electric sleep procedures were performed on this rabbit with a different pulsating current frequency, for example, 12. On the same rabbit, electric sleep procedures were performed both with the cutaneous arrangement of the electrodes and under conditions where the pulsating current was hooked up to implanted electrodes. At the end of all the experiments the rabbits were sacrificed, and their brains were photographed and subjected to cytoarchitectonic analysis. Every fifth section of the series of frontal sec-

tions (thickness of sections, 20μ) was stained by the Nissl method. Then, the location of the implanted electrodes was determined microscopically. In addition, roentgenograms of the rabbit skulls were made which made it possible to judge the position of the implanted electrodes during the life of the animal.

The results of the investigation, which we are presenting with the kind consent of the author, amount fundamentally to the following. The changes in electrical activity of the human brain which occur during electric sleep are similar to those which are usually observed in the condition of physiologic sleep. When the subject has an α -rhythm in the initial state the latter increases somewhat in its amplitude, becomes more synchronous, and then begins to disappear in an interrupted manner. These observations are similar to ours, which have been presented, for example, in Fig. 22. In cases of asynchronous activity in the waking stage (Fig. 23, A) under the influence of the pulsating current the amplitude of the fast waves on the electroencephalogram begins to decrease, and individual α -waves appear which change over into an α -rhythm (Fig. 23, B). The amplitude and synchrony of the α -rhythm increase, and then the α -rhythm begins to disappear in an interrupted manner (Fig. 23, C). Gradually, the periods during which the α -rhythm is absent from the electroencephalogram become longer (Fig. 23, D), which usually corresponds to the transitional state from waking to sleep. The latent period of reflex reaction has increased, and differentiation is disinhibited. In certain cases it is possible to observe also a complete inversion of the effect of the stimulus, where a reaction occurs in response to a negative conditioned signal, and there is no reaction to the positive conditioned signal.

In the course of time the α -waves on the electroencephalogram are replaced by β -waves, which change over into a β -rhythm (Fig. 23, E). Slowing of the dominant rhythm of the waves from 11-12 to 6-7 per second means a reduction in the functional mobility of the cortical cells and actually signifies the development of an inhibitory state in the cerebral cortex. There are no conditioned reactions. However, in response to external stimulation (conditioned sound signal), despite the absence of a conditioned reaction, a synchronized α -rhythm of quite large amplitude (see Fig. 23, E) reappears for a short time on the electroencephalogram; this promptly disappears and reappears in response to the conditioned signal. Only in the stage of deep sleep, where

the frequency of the dominant β -rhythm is decreased to three to four waves a second, does the conditioned stimulus stop producing notable changes in the electroencephalogram (Fig. 23, F). Such a stage of deep sleep is much less common during electric sleep than in pharmacologic sleep. In the same patient the depth of electric sleep may be different in different procedures. Sometimes, it is possible to observe quite deep sleep even during the first electric sleep procedure. During subsequent procedures a similar character of the electrical activity changes in the brain is noted, but they develop more quickly. In a number of cases, after the first few electric sleep procedures, the patients no longer slept in the subsequent procedures, or, on the other hand, which was observed more often, sleep occurred only beginning with the fourth to sixth procedure. In these cases, during the procedures preceding the one in which the patient falls asleep the changes of electrical activity described above are observed on the electroencephalograms, but they do not reach the stage where α -waves appear. In cases of deep electric sleep it is possible to observe conditioned reflex sleep not uncommonly after several procedures; this occurs when the patient is put under conditions for the administration of electric sleep. Electroencephalograms of such conditioned reflex sleep are similar to those described above.

Finally, there are cases where sleep does not occur at all under the influence of the pulsating current. However, regardless of this, definite changes gradually appear on the electroencephalograms which are manifested in the fact that the α -rhythm becomes the dominant wave process and the differences in the character of electrical activity of various parts of the brain practically disappear. In the absence of sleep the occurrence of changes on the electroencephalograms under the influence of the pulsating current are demonstrated particularly clearly in persons with the asynchronous type of electrical activity or in patients on whose electroencephalograms there is variegation in the waking state. Gradually this variegation disappears after several electric sleep procedures, the high frequency waves become less noticeable, the α -rhythm appears in all the leads (Fig. 24, A-H).

Regardless of whether or not the patient slept during the electric sleep procedures, after 8 or 10 procedures the α -rhythm becomes the dominant type of activity in all the leads. The presence of a well synchronized α -rhythm is observed not only after a routine electric sleep procedure;

the α -rhythm remains the predominant wave process even several hours after it, as control electroencephalographic records show which are made on the following day before beginning the procedure. After 18-20 procedures, the changes which occur in electrical activity of the brain are maintained for two to three weeks (Fig. 24, I).

In the cases where sleep is absent in the patients the existence of definite changes in electrical activity of the brain under the influence of a pulsating current attest to the direct effect of the current on the central nervous system. With the aim of changing this and also of clarifying the problem as to whether or not sleep inhibition is induced in electric sleep by the rhythmical stimulation of tactile receptors, experimental investigations were carried out on rabbits with implanted electrodes. It is entirely understandable that in connecting the current to the implanted electrodes electric sleep be produced under conditions where the possibility of tactile reception is eliminated. However, regardless of this, in the majority of animals electric sleep occurred, and the electroencephalographic changes which appeared under the influence of the pulsating current both in the condition of sleep and in its absence were no different from those which were observed in the cutaneous arrangement of the electrodes. This repudiates the decisive role of the tactile receptors in the development of sleep inhibition in electric sleep procedures. In all cases, under the influence of the pulsating current regardless of its frequency (6, 10, 12 or 18 impulses/second) the optimal excitation rhythm was manifested on the electroencephalogram which attests to stimulation of the subcortical area by the current.

As is known, the optimum excitation rhythm of any structure in electrophysiology means some definite rhythm which shows a tendency to manifest itself obtrusively both in response to the most varied influences from without and by way of "spontaneous" activity of the tissue. Our own observations as well as data in the literature permit us to consider the optimum excitation rhythm of the thalamus to be a rhythm with a frequency of five to six waves a second.

The demonstration of the low amplitude of this optimum rhythm of excitation of the thalamus under the influence of a pulsating current can sometimes be observed even as early as the first electric sleep procedure. This was the case, for example, in rabbit No 3 (Fig. 25, A). As early

as 15 minutes after the pulsating current with a frequency of 18 impulses/second was turned on fast waves appeared on the electroencephalogram, and waves with a frequency of five to six per second were noted rhythmically on the electrothalamogram, the amplitude of which increased with the increase in the time of action of the pulsating current (Fig. 25, B, C). After the occurrence of a distinct rhythmicity on the electrothalamogram slow waves appeared in the cortex and spindle-shaped configurations with a frequency of 12-14 waves a second and of large amplitude are found (Fig. 25, E). At this time, the animals are usually quiet and lie peacefully in the stall, even without being tied. A state of light drowsiness occurs.

With the continuance of the effect of the pulsating current, usually in the third or fourth electric sleep procedure, and sometimes even in the first, the β -waves which appear promptly begin to become dominant in the record (Fig. 26, C, D, E, and F). The animal begins to become drowsy, its ears fall, and the respiration becomes slow. Fast waves, which are superimposed on the β -waves, gradually disappear (Fig. 26, G), and the β -rhythm gradually slows still further (Fig. 26, H). Along with the slowing of the dominant cortical rhythm, which attests to the development of an inhibitory state in the cortex, a slowing of the rhythm also begins on the electrothalamogram (Fig. 26, F and G). However, considerable external stimulation -- sound, light or tactile -- produces an increase in frequency of the rhythm to the initial frequency and a disappearance of β -waves from the cortical electroencephalogram (see Fig. 26, G). The animal wakes up. With the continuance of the effect of the pulsating current the rhythm slows up progressively on the electroencephalo-electrothalamogram, which indicates the progressively greater decrease in the functional mobility of the cortical and subcortical cells and the deepening of the inhibitory state in the cortex and subcortex. The animal sleeps deeply. Not only sound, light and tactile stimulation, but even passive movements of the extremities and ears do not cause it to awaken. The conjunctival and defensive reflexes are considerably decreased. Such sleep may continue even after the pulsating current has been turned off. Its duration sometimes reaches two hours. After the animal awakens this optimal excitation rhythm reappears on the electrothalamogram, and there are fast waves on the electroencephalogram (Fig. 26, I, J and K).

It should be noted that the condition of deep electric sleep in animals is observed quite rarely. Sleep is more

often. Thereby, phasic changes in electric sleep are very volatile and fluctuating: now the animal sinks into sleep, now it awakens, and again is drowsy. On electroencephalograms taken in the state of electric sleep usually periods of considerable slowing and increase in frequency in the dominant rhythm of the electrical waves (Fig. 27) are recorded which replace each other quite rapidly. The optimum excitation rhythm of the thalamus detected through the effect of the pulsating current is maintained for hours, and when the electric sleep procedures are performed every day it can be found on the records of electrical activity of the thalamus also on the following day. Usually, this is observed after four or five electric sleep procedures (Fig. 28).

With the increase in the duration of action of the pulsating current (during a single procedure and in the entire number of them) the optimum excitation rhythm on the electrothalamogram is demonstrated for a progressively longer time, so that after 18-20 procedures it is retained for two to three and sometimes even four weeks. While a rhythm of five to six waves a second is the optimum excitation rhythm for this subcortical structure, the thalamus, the optimum excitation rhythm for the human cerebral cortex should be considered the α -rhythm, that is, a rhythm which has a frequency of 8 to 12 waves a second. This optimum excitation rhythm of the human cortical structure, just like the optimum excitation rhythm of the thalamus of animals, is demonstrated on the electroencephalogram regardless of the frequency of the current impulses (6, 10, 12 or 18 a second). Therefore, regardless of the frequency of the external stimulation the brain tissue reacts to it with its own optimum excitation rhythm.

It is known that regardless of the specific characteristics of the external stimulation the excitable units pass particularly readily and distinctly into the equalizing stage of parabiosis in response to a routine of reacting in the same excitation rhythm. Therefore, it should be supposed that a weak pulsating current of low frequency exerts a parabolic effect on the brain tissue. However, the degree of parabiosis of the cerebrum is limited to the equalizing stage of the latter.

A characteristic feature of the optimum excitation rhythm, as may be seen from the actual material, is its great persistence in time. After beginning in the thalamus and

cerebral cortex the optimum excitation rhythm is maintained for hours, and when the electric sleep procedures are used every day, for weeks.

Another characteristic feature of the rhythm which occurs under the influence of a pulsating current is the constancy of its amplitude.

L. V. Latmanizova, investigating the electrical activity of the solitary nerve fiber and of the muscle unit and noting these two characteristic features of the optimum excitation rhythm of the nerve and muscle tissue, believes that constancy of the potential amplitudes of the optimum rhythm is an indication of the fact that "the tissue which is in a given frequency routine of activity succeeds in restoring its working potentials completely after each successive session of activity". From this point of view, the optimum excitation rhythm reflects the optimum conditions of the rhythmic activity of the tissue, which contributes to normalization of disturbed functions, particularly of vegetative functions. Apparently, this also explains the fact that sometimes in the absence of sleep during the procedure the general feeling of well being of the patients improves, and normalization of night's sleep occurs.

In the majority of cases, as has already been noted, a certain time after the occurrence of an optimum excitation rhythm on the electrothalamograms a slowing of the dominant wave processes is noted on the electroencephalograms, and this is evidence of a decrease in the lability of the cortical cells and actually signifies a transition of them into an inhibitory state. Therefore, despite the fact that the subcortical centers of the brain are in the area of the most intense effect of the current, because of the distinct structure of the skull, the transition to an inhibitory state is observed first in the cortex as the most reactive portion of the central nervous system. This once again confirms the statements by I. P. Pavlov that subcortical cells possess "a Bogatyr's strength" [Bogatyr was a hero of old Russian folklore] and are much more resistant than the cortical cells. The possibility also exists that the development of an inhibitory state in the cortex is partly associated with the inhibitory effect of monotonous direct current pulsations.

In addition, the inductive interrelationships existing between the cortex and subcortex contribute to a consider-

able degree to the development of inhibition in the cortex. The focus of excitation in the thalamus created through the effect of the pulsating current is responsible for a decrease in the lability of the cortical cells, by the same token contributing to the development of inhibitory states in the cortex.

The electrographic changes described above are evidence of the progressively developing cortical inhibition, as is also the gradual extinction of conditioned reflex activity. In the majority of cases, inhibition develops in electric sleep only in the cerebral cortex and irradiates to the subcortex only in certain cases. These differences in the intensity and extent of the inhibitory process are apparently conditioned by the individual characteristics of central nervous system activity of the subject. Among these characteristics mention should be made primarily of the nature of the cortical-subcortical interconnections.

N. M. Liventsev, A. F. Strelkova and V. S. Vozdvizhenskaya made comparative observations of the reactions to the effect of electric sleep, its depth and of the clinical effect in patients with sequelae of traumatic disease after simple and compound skull trauma. In the case of compound skull trauma the active electrode was not applied to the orbits but rather to the skin covering the defect in the bones of the skull vault in the area of the trauma, that is, in this case the current was brought into the brain directly, missing the peripheral nerve structures of the lids, orbits, et cetera unlike the usual method. The second electrode was placed the same as usual. The results of the effect of the pulsating current according to this method (more than 40 observations) should show no particular differences when compared with the results of the effect of the current according to the usual method. Nor was there any great difference in the observations made by means of electroencephalography (data of V. S. Vozdvizhenskaya).

Control procedures with the application of the electrode to the skull defect but without turning on the current did not produce sleep or a therapeutic effect or electroencephalographic changes.

These observations show graphically that electric sleep is produced chiefly through the effect of a pulsating current on the brain, and thereby the method of bringing the current in -- through the orbits or through a defect in the bones of the skull vault -- is not of decisive importance.

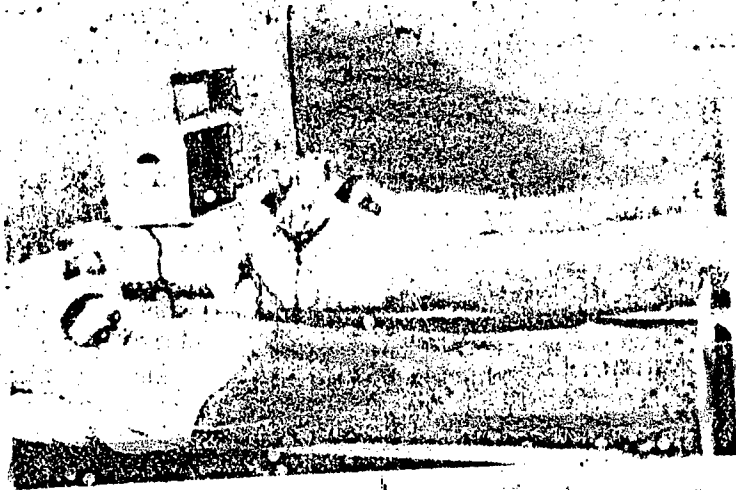


Fig. 9. The Administration of Electric Sleep in a Pediatric Ward



Fig. 10. Electric Sleep. Patient Ye. is Sleeping Under the Influence of a Pulsating Current



Fig. 11. Electric Sleep. Patient Ye. is Continuing to Sleep After the Current is turned Off and the Electrodes Have Been Removed.



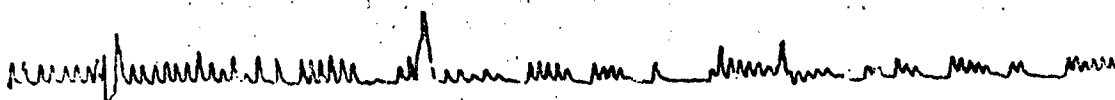
Fig. 12. Electric Sleep. Patient B is Sleeping Under the Influence of the Pulsating Current.



Fig. 13. Electric Sleep. Patient B is Continuing to Sleep After the Current Has Been Turned Off and the Electrodes Removed.



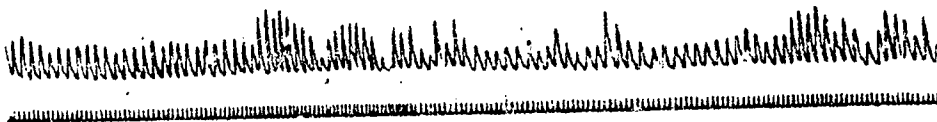
Fig. 14. Normalization of the Respiration in Electric Sleep. Patient K. Diagnosis: Schizophrenia. Arrhythmical Curve of Respirations: One Minute and 25 Seconds After Turning on the Pulsating Current the Respiration Became Rhythmical and Deep: The Patient Did Not Sleep.



a



b



c

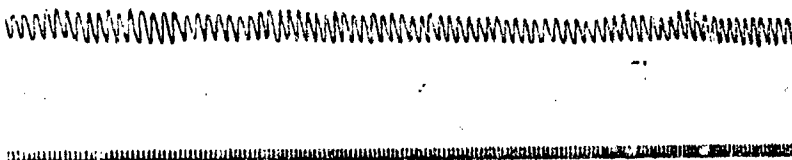


Fig. 15. Normalization of Respiration in Electric Sleep. Patient Kh. Diagnosis: Reactive State With Prolonged Insomnia.

a -- beginning of the procedure; 20 seconds after the current was turned on periodic respiratory rhythm appeared;
 b -- period of falling asleep: the respiration became regular, but with periodic variations in amplitude; c -- period of sleep: respiration regular (regular amplitude).

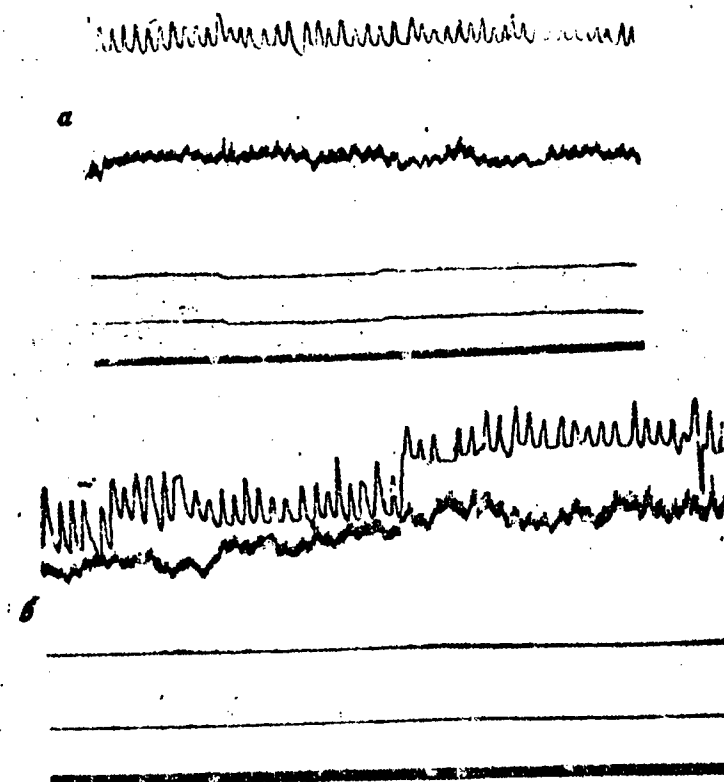


Fig. 16. Normalization of the Plethysmogram in Electric Sleep. Patient B. Diagnosis: Schizophrenia, Paranoid-Hypochondriacal Type.

a -- before electric sleep; weakly expressed respiratory waves; b -- during electric sleep, more pronounced respiratory waves and third-order waves.

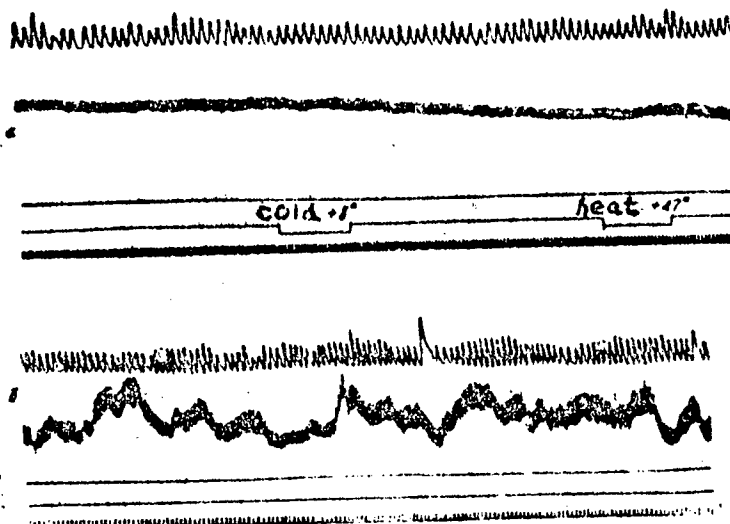


Fig. 17. Normalization of Plethysmogram in Electric Sleep. Patient M. Diagnosis: Schizophrenia, Simple Type.

a -- before electric sleep; zero background, second- and third-order waves absent; no reactions to temperature stimuli; b -- during electric sleep; increase in the pulse waves, pronounced second- and third-order waves.

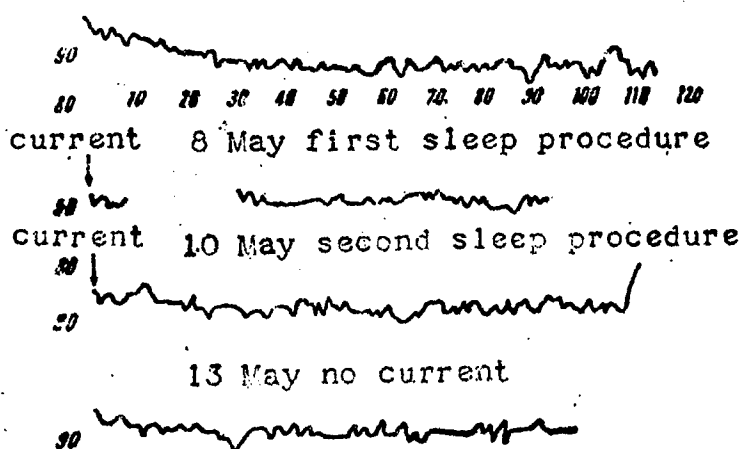


Fig. 18. Oxyhemograms of Patient N. Diagnosis: Reactive Depression (Explanation in Text)

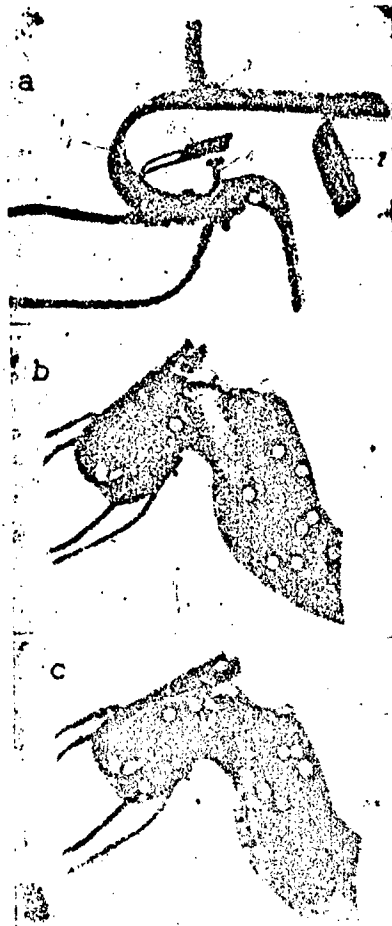


Fig. 19. Adaptation For Examination of Motor-Defensive Reactions to Electrocutaneous Stimulation (Explanation in Text)

a -- external appearance; b -- fingers appressed to contacts through which the electrical stimulation is administered; c -- fingers flexed (motor-defensive reaction)

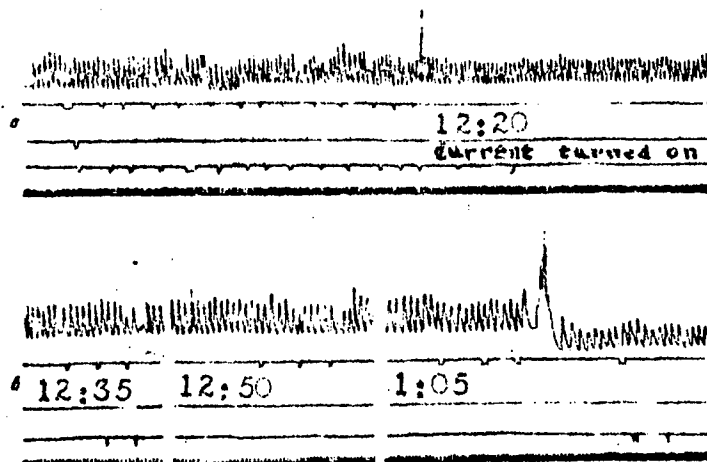


Fig. 20. Record of the Dynamics of the Conditioned Motor-Defensive Reaction During Electric Sleep. Patient A.

a -- before the current was turned on; b -- after the current was turned on (upper record -- pneumogram; then, from above down, record of conditioned stimulus, unconditioned stimulus, motor-defensive reaction, and time at two-second intervals).

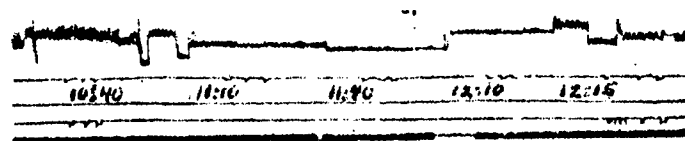


Fig. 21. Record of Dynamics of Conditioned-Motor-Defensive Reaction During Electric Sleep. Patient A. (Key is the Same as For Fig. 20.)

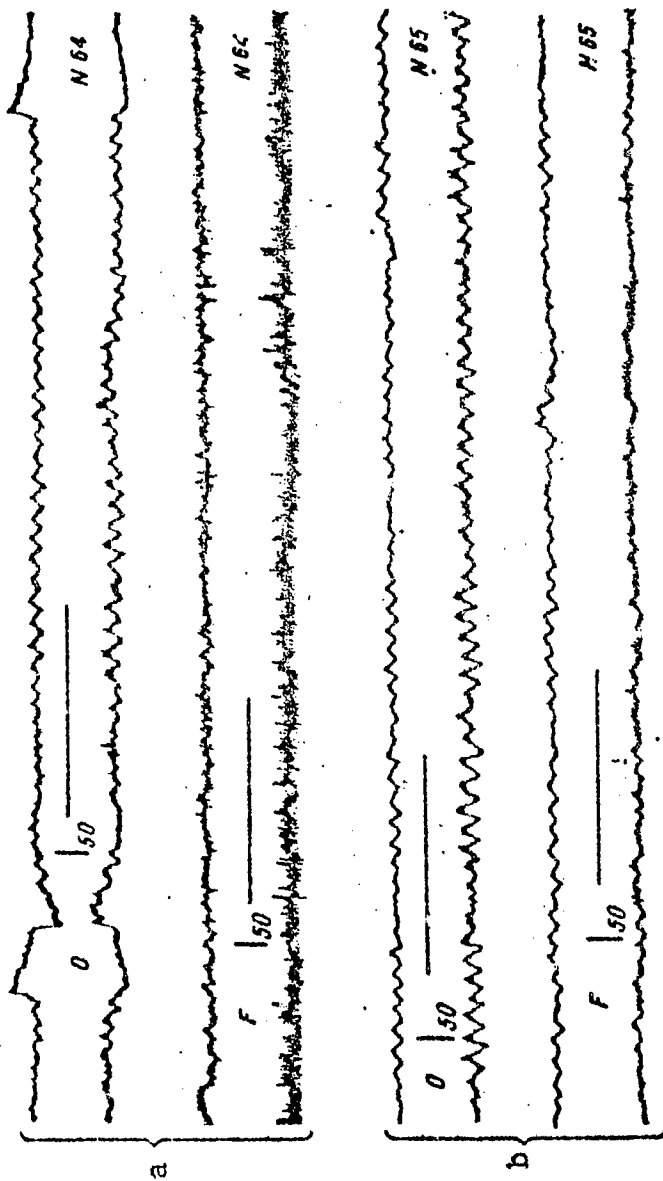


Fig. 22. Electroencephalograms Taken During Electric Sleep in the Absence of a Conditioned Reflex. Patient A.

a -- before beginning electric sleep; b -- 30 minutes after beginning electric sleep.

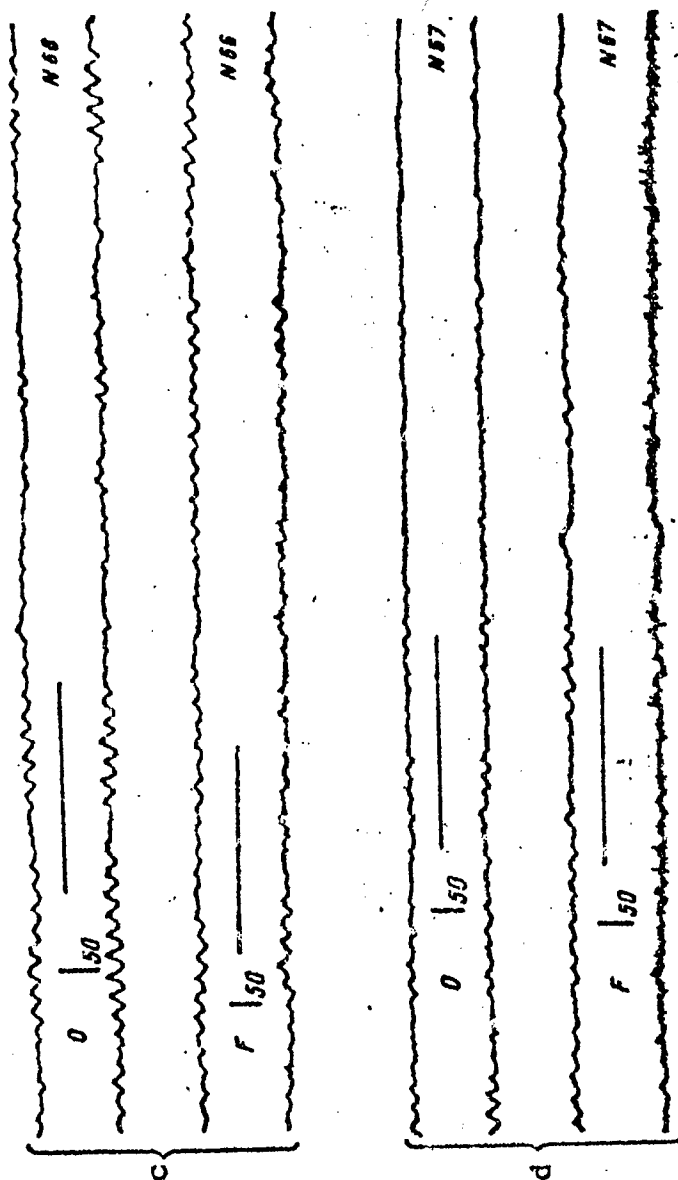


Fig. 22. [continued] c -- An hour after the onset of electric sleep;
 d -- 1 1/2 hours after the onset of electric sleep;

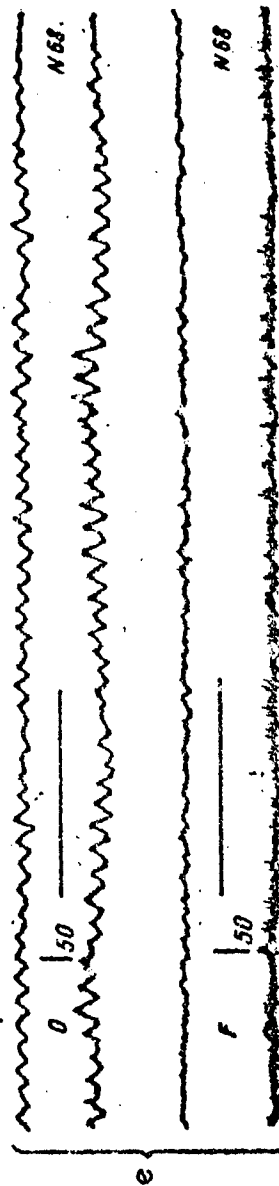


Fig. 22. [continued] e -- after waking from electric sleep.

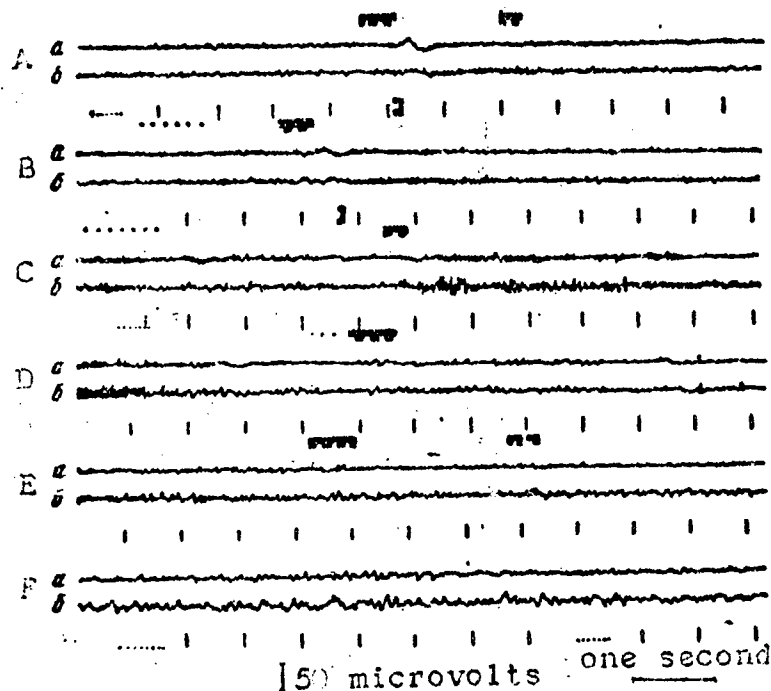


Fig. 23. Electroencephalograms of Patient A Recorded During the First Electric Sleep Procedure

a -- fronto-temporal lead of left hemisphere; b -- parieto-occipital lead of left hemisphere. A -- initial background; B, C, D, E, F -- record 15, 30, 45 minutes, 1 hour, 1 hour 15 minutes after the current has been turned on; single mark over each electroencephalogram -- positive conditioned signal; double mark -- negative conditioned signal; mark below the electroencephalograms -- response reaction (pressure on a bulb) (observation of I. S. Robiner).

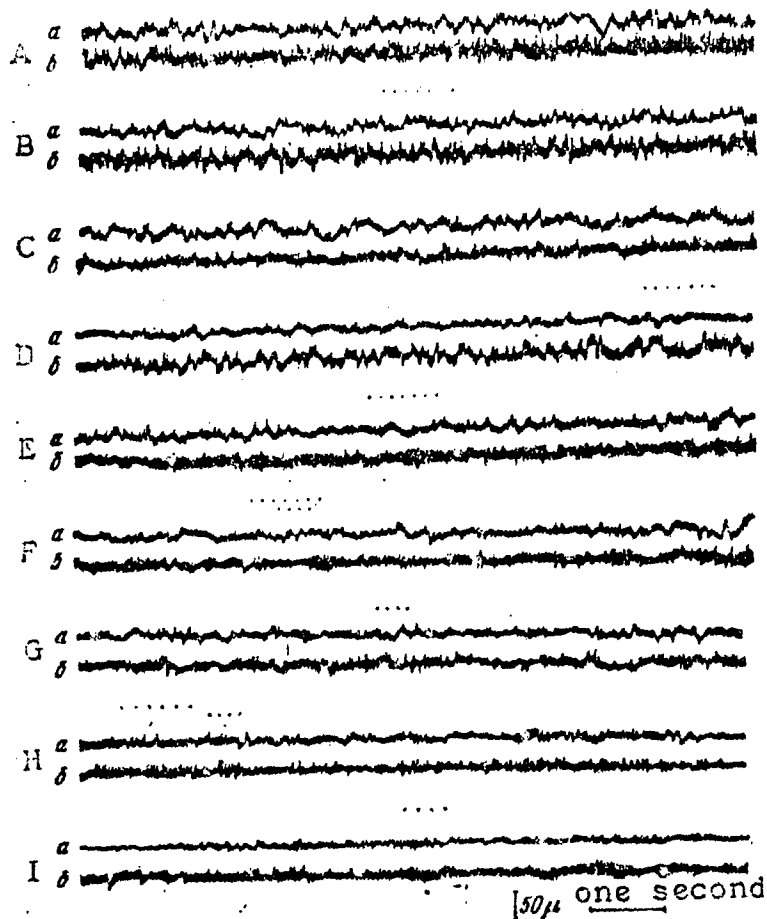


Fig. 24. Electroencephalograms of Patient S., Who Never Fell Asleep Under the Effect of the Pulsating Current.

a -- record in the fronto-temporal lead; b -- record in the parieto-occipital lead. A, B, C, D, E, F, G, H -- records before beginning first, third, fifth, seventh, ninth, 11th, 15th and 19th electric sleep procedures; I -- record two weeks after the 19th electric sleep procedure (observation of I. S. Robiner).

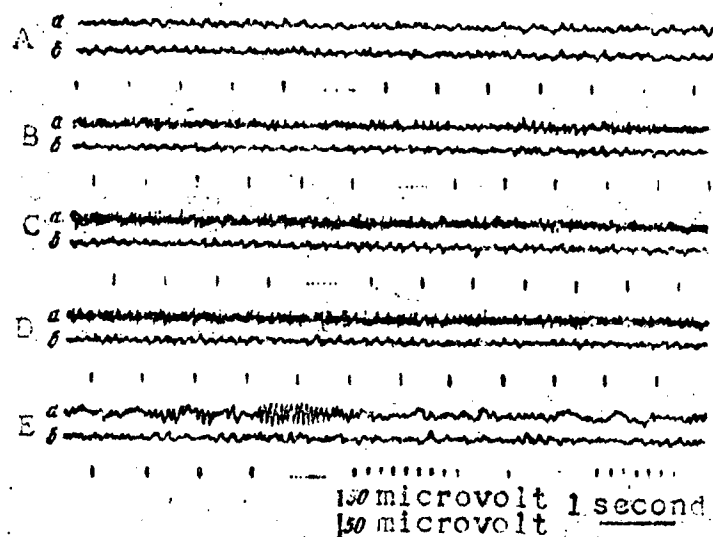


Fig. 25. Electroencephalograms of Rabbit No 3 Taken During the First Electric Sleep Procedure

a -- of the cortex; b -- of the thalamus; A -- record before beginning first procedure; B, C, D, and E -- record after switching on the current, each taken 15 minutes after the preceding (observation of I. S. Robiner)

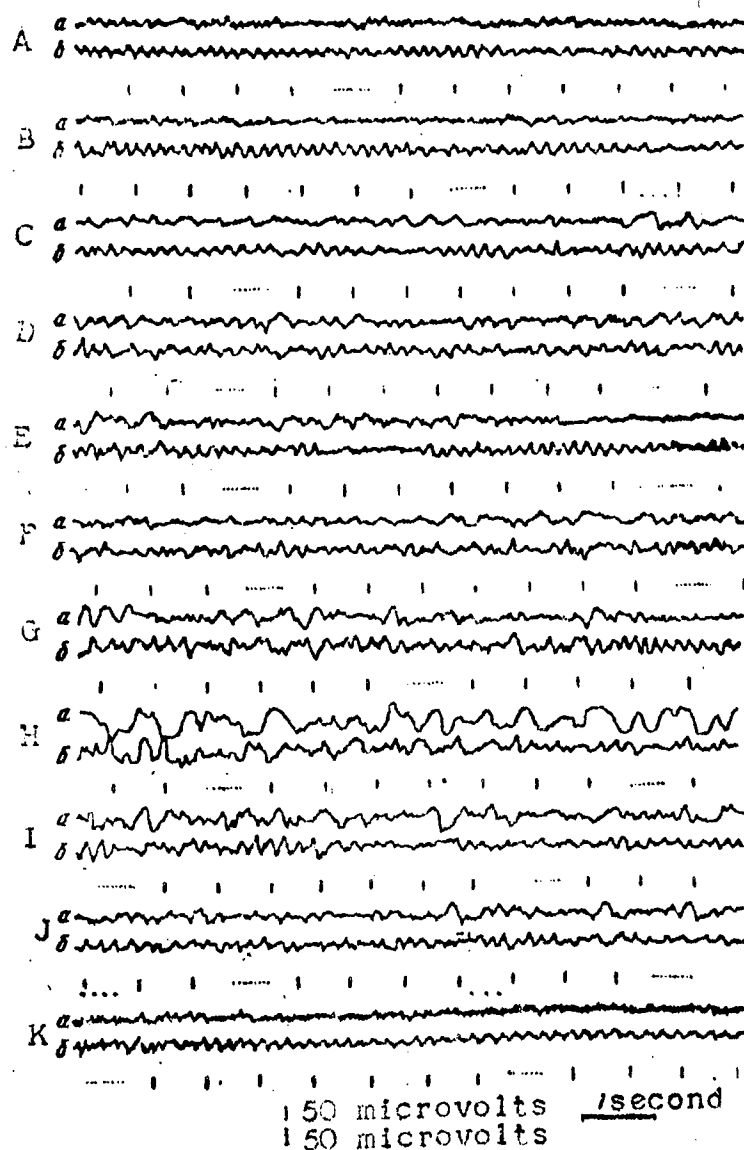


Fig. 2b. Electroencephalograms of Rabbit No 3 Taken in the Third Electric Sleep Procedure

a -- of the cortex; b -- of the thalamus; A, B, C, D, E, F, G, H -- records after switching on the current, each 15 minutes after the preceding; I, J, K -- taken one hour, one hour and 15 minutes and one hour and 30 minutes after switching the current off (observation of I. S. Robiner)

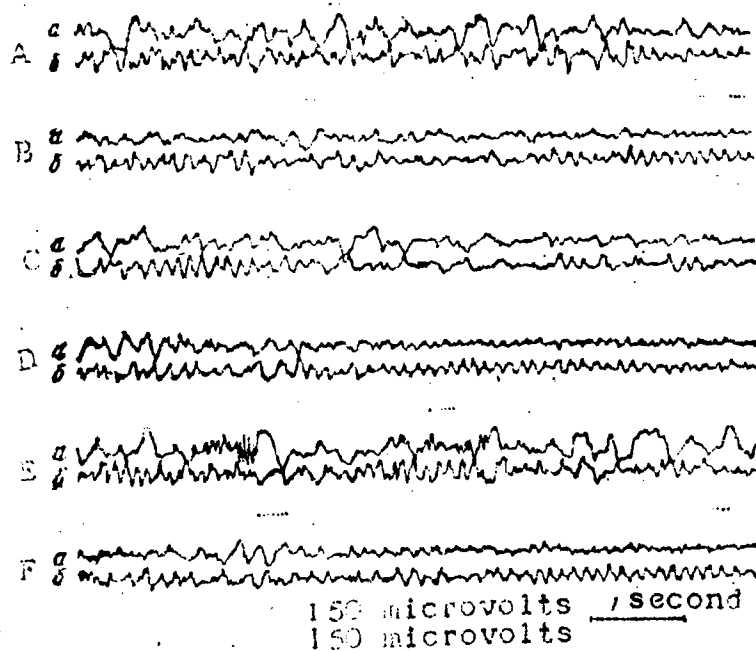


Fig. 27. Electroencephalograms of Rabbit No 3 Taken For 12 Minutes in the Fifth Electric Sleep Procedure and Hour After Switching on the Current.

a -- of the cortex; b -- of the thalamus; A, B, C, D, E, F -- each taken two minutes after the preceding procedure (observation of I. S. Robiner).

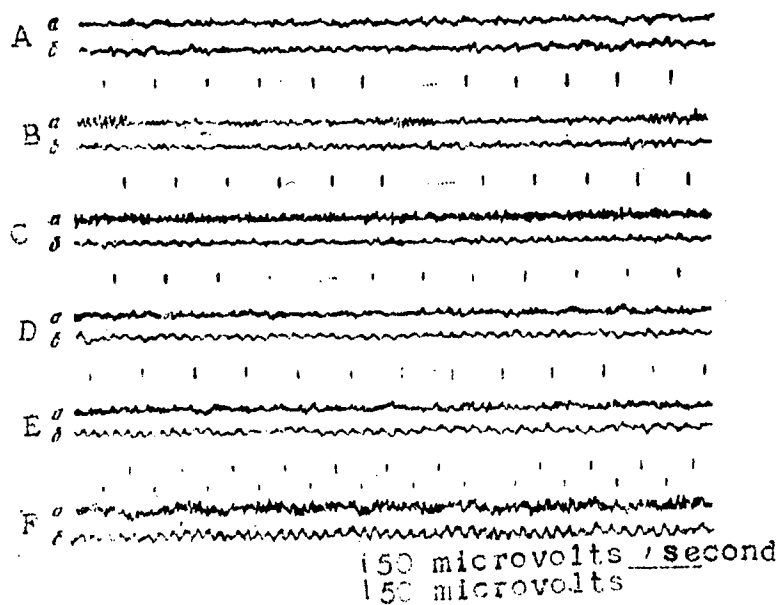


Fig. 28. Electroencephalograms of Rabbit No 3

a -- of the cortex; b -- of the thalamus. Record before beginning procedure of electric sleep: first (A), second (B), third (C), fourth (D), fifth (E), sixth (F) (observation of I. S. Robiner).

SECOND PART

CLINICAL OBSERVATIONS

CHAPTER ONE

The Application of Electric Sleep to Psychiatric Practice

1. General Comments

One of the essential problems of psychiatry is that of filling the arsenal of therapeutic measures with new, theoretically sound and adequately effective methods. The progress of Soviet psychiatrists in the matter of treatment has been achieved to a considerable degree because of the fact that in using various methods they, at the same time, have carefully studied the changes in the clinical picture of the disease. It is very important not only to establish the existence of recovery or more or less considerable improvement but also to study the dynamics of the psychopathological picture, particularly the order of regression of the symptoms.

In matters of treatment we have used Pavlovian principles both of protective inhibition and of increase in excitability of the cerebral cortex as a foundation.

The experience in the work of Soviet psychiatrists in the treatment of patients has made it possible to establish two important facts: first--the same treatment principle may be fulfilled by various measures, each of which may have its own characteristics; second--the significance of the type of higher nervous activity of the patients for the results of treatment. It has been noted a long time ago that active persons capable of overcoming the difficulties of life can cope with disease more readily. The teaching of I. P. Pavlov concerning the types of higher nervous activity makes it possible to explain why the same methods of treatment do not always give the same results. The positive attitudes of the patient himself to one treatment or another are also of importance. In this connection, the conditions for sleep treatment are particularly favorable, since it is known to broad masses of people that the great physiologist [Pavlov] provided a theoretical basis for this method.

At the present time, we are disposed of observations of 300 patients treated with electric sleep in the Institute of Psychiatry of the Ministry of Health USSR. The effectiveness of treatment is directly connected with the nature of the disease, its duration and characteristics of its course. We have observed the greatest effectiveness of electric sleep in patients with neuroses and also in patients with reactive and asthenic conditions.

In psychiatric practice the results of treatment of children suffering from the choreic form of rheumatic encephalitis as well as from neuroses and reactive conditions are attracting particular attention. These data will be presented in a special chapter. As far as the data concerning electric sleep treatment of patients with schizophrenia are concerned, we have obtained the greatest therapeutic effectiveness in patients with psychoreactive onsets of schizophrenia or in the case of an exacerbation of the process following psychic trauma; thereby, functional onlays were removed primarily, although the principal psychopathological symptom processes (hallucinations and delusions) also underwent regression. We obtained a favorable effect in patients with the hallucinatory-paranoid type of schizophrenia. If electric sleep treatment did not give any beneficial effect we combined electric sleep with therapeutic doses of insulin, bringing the patient to a state of slight hypoglycemia. We performed the electric sleep procedure immediately after stopping the hypoglycemic state.

In clinical practice we used four variants of the methods of administering electric sleep treatment in courses.

First method. The electric sleep procedures were carried out daily, gradually increasing the duration. The first procedure lasted 30 minutes; the second, one hour; the third, 1½ hours, and beginning with the fourth procedure, two hours. The total number of procedures per course of therapy was established according to the changes observed in the patient's condition, and was, on the average, from 10-12 to 20 procedures.

Second method. Prolonged electric sleep routines. After

studying the routines of application of the procedure according to the method mentioned above we attempted to approach a method similar to interrupted pharmacologic sleep. For this purpose we gradually increased the duration of the procedure with the pulsating current to seven hours a day in the following way: the morning procedure lasted four hours, and the evening procedure lasted three hours (with a six-hour interruption between the procedures). During the entire course of treatment the patients were in a special ward. Therefore, we succeeded in prolonging the physiological sleep of the patients to 12-17 hours a day. Aside from the double procedure described, we also used single electric sleep procedures during the morning hours prolonged to four to 4½ hours. The total per course of treatment was 20 procedures.

Third method. The combined use of electric sleep and small doses of insulin chiefly in patients with schizophrenia. In working out this method we were guided by the works of A. G. Ivanov-Smolenskiy in which he showed the expediency of applying combined methods of treatment in patients with schizophrenia. In his opinion, prolonged sleep, by deepening the protective inhibition and, by the same token, freeing the cerebral cortical cells from the effect of exhaustion and intoxication, can not always definitively eliminate the existing vegetative and metabolic disturbances which are the source of pathological, chiefly toxic effects which affect the central nervous system.

Since we regard electric sleep as one of the variants of the sleep treatment it seemed justified to us to make an attempt to use it, first of all, in combination with detoxification measures, such as insulin, which, as is well known, tonicizes the vegetative nervous system at the same time. Sometimes, we prescribed electric sleep with insulin both for reactive states and chronic neurotic reactions in which the main disease was complicated by signs of somatic weakness.

The method of combining application of electric sleep with insulin was the following. Every morning the patients were injected with insulin, beginning with two to four units

and gradually increasing the doses to 12-15 units. Two and a half hours after the injection of the insulin glucose was injected intravenously (20 cubic centimeters of the 40 percent solution), and after breakfast an electric sleep procedure was performed lasting three to four hours. The duration of such a course of treatment was three weeks.

Fourth method. Was used in the pediatric psychiatric hospital. The electric sleep procedures were much shorter (within limits of from 30 minutes to one hour). The maximum current strengths did not exceed five to seven milliamperes in the amplitude value of the impulse and the duration of the impulse was 0.2-0.3 meter/second. The procedures were performed daily. The total number of procedures per course of treatment depended on the condition of the patients, being, on the average, from 10 to 15 procedures.

2. Neuroses, Reactive and Asthenic States

Clinical psychiatry has accumulated a tremendous experience on the symptomatology and treatment of neurotic states. However, at the present time various theories of the pathogenesis of neuroses exist.

Soviet psychiatrists adhere to the physiological theory of I. P. Pavlov, who in his experimental research performed on animals obtained a model of the neuroses, gave it a pathophysiological explanation and a basis for their treatment. I. P. Pavlov showed that excessive strain of the nervous system underlies neuroses which may occur by virtue of various reasons: overstrain of the stimulatory or inhibitory process or of conflict--the collision of these processes. It was also shown that the same causes produce dissimilar functional disturbances in various animals. These differences depend on the type of higher nervous activity of the animals. Most frequently, the extreme types --weak and strong unbalanced (unrestrained type) types--suffer from neurosis. However, under special conditions it has been possible to obtain neurotic states in animals of the strong well balanced type; with this aim in view the animals were given either exceptionally difficult problems

requiring special strength and mobility of the fundamental nerve processes, or the nervous system of the animal was first weakened.

In the experiments of M. K. Petrova it has been shown that castration leads to a marked weakening of the type of higher nervous activity and to the occurrence of neurotic states. An analysis of the clinical observations led I. P. Pavlov to the conclusion that the interrelationship of the signal systems is of importance also in the clinical expressions of human neuroses. In this way, a classification of the neuroses was crystallized out, at the basis of which well known clinical forms were used, and they were given a pathophysiological interpretation.

In distinguishing neurasthenia as a particular state of exhaustion of the nervous system occurring in persons of the weak or unrestrained type as a result of overfatigue or overstrain, I. P. Pavlov distinguished two forms of it: in some cases there was a weakening of the processes of internal inhibition; in others, a weakening of the stimulatory process. He studied the pathophysiological mechanisms of hysteria in particular detail. According to I. P. Pavlov, hysteria develops in people of the weak type of nervous system when there is a predominance of activity of the first signal system and a weakness of the second signal system under the influence of factors traumatizing the psyche. In the presence of severe psychic trauma hysteria may develop also in representatives of the strong type. A disturbance in the interaction of the cortex and subcortex, where weakness of the cerebral cortex occurs which readily passes into an inhibitory state, is essential for hysteria; thereby, there is positive induction in the subcortex, which leads to emotional and affective outbreaks and primitive motor reactions (Ye. A. Popov).

Psychasthenia is a neurosis characteristic of people of the weak type of nervous system with a predominance of activity of the second signal system compared with the first. Thereby, there is also a weakness of emotional activity. In compulsive-obsessive neurosis I. P. Pavlov saw the expression of isolated pathological inert points in the patients, where-

by "a single series of sensations and concepts associated with the pathological cells is made abnormally stable and does not submit to the restraining influence of numerous other sensations and concepts which correspond better to reality owing to the healthy state of their cells". I. P. Pavlov recommended relaxation and rest for the central nervous system for the treatment of neurotic breaks as well as the combination of bromides with caffeine for the purpose of regulation of the disturbed relationships between the fundamental nerve processes.

Regarding electric sleep as a method of producing protective inhibition, we used it in neuroses and reactive states. The best therapeutic results were obtained in neurasthenia and various asthenic states of somatogenic, post-traumatic and psychogenic etiology. The hysterical reactions likewise submitted well to the electric sleep treatment. We observed a much less favorable effect in compulsive-obsessive neurosis. Evidently, because of the stability of the pathologically inert points the effect of electric sleep is weak and does not produce any good therapeutic result.

The results of treatment of various reactive states, which represent the neurotic states produced by psychogenic trauma--acute and chronic,--were very good. Electric sleep treatment is of importance specifically in the chronic reactive states--psychogenic depression, psychogenic paranoid conditions; however, at times even such acute reactive states as psychogenic stupor and psychogenic mutism may also respond to electric sleep treatment. Let us proceed with the presentation of our observations.

Patient N., age 44, was treated in the hospital of the Institute of Psychiatry from 19 January through 16 April 1953.

She came from a healthy family. She developed normally. She completed four grades of primary school. She had no definite specialty. Recently, she had been working as a computer in a printing house. In childhood she suffered from smallpox. In 1942, during an air attack she sustained

multiple shell fragment wounds of the soft tissues of the upper extremities and of the chest cage. She was operated three times for intestinal obstruction. In 1949, she sustained head trauma with signs of cerebral concussion. She has been treated since this time. She was married, had seven pregnancies which terminated in delivery, but only two children remained alive. By nature she was asthenic, sociable, direct, and able to face the truth. Beginning with 1950, her character changed: she became irritable, excitable; during excitement she fell on the floor, cried out, beat her hands and feet against the floor. She was frequently troubled by headaches. In the summer of 1951 the headaches became particularly severe, her sleep was disturbed, she became melancholic, and it seemed that "everybody was looking at me and talking about me". She was placed in the Hospital imeni Kashchenko, where she remained about three months. She recovered, began to work. Her condition deteriorated again beginning with December 1952 in connection with a severe illness and the death of her mother whom she had been nursing for several months. She had only a hazy picture of the burial of her mother and everything which followed. She was as though "in a fog". She remembered that she fell down, cried out, could not eat, and had nightmares. She had the idea that she was also sick with cancer, as her mother had been. She was afraid of death.

Objectively, the patient showed a loss of weight. There was bronchial breathing in the lungs and dry rales. The pulmonary percussion sound was clear. The left border of relative cardiac dullness was at the mid-clavicular line; the right, at the right margin of the sternum. The heart sounds were pure. Pulse was rhythmical and of satisfactory quality. The blood pressure was 70/40 millimeters. The liver and spleen were not enlarged. The abdomen was soft and was not tender on palpation. There were post-operative scars in the mid-line of the abdomen and right iliac area.

Fluoroscopy of the chest cage showed the following: the lung roots were prominent, with dense lymph nodes; the lung fields were clear; the costophrenic sinuses were clear; there was no restriction of the mobility of the diaphragm.

The heart was not enlarged; the pulsations were of moderate strength. The aorta was normal.

Analysis of the blood: hemoglobin, 65 percent; red blood count 4,200,000; white blood count 4,000, basophils one percent, eosinophils one percent, stabs three percent, segmented neutrophils 31 percent, lymphocytes 60 percent, monocytes four percent; sedimentation rate 12 millimeters in an hour. The blood Wasserman test was negative. The urine showed no abnormalities.

Nervous system: the optic fissures were unequal; the pupils were of regular shape; their reaction to light and on convergence was satisfactory; there were no oculomotor disorders; the other cranial nerves showed no abnormalities. The tendon reflexes were equal and lively. There was a tremor of the lids and fingers of the outstretched hands.

Before treatment she was melancholic, depressed, at times lay in bed covering her face with her hands, and at other times she walked around the ward, groaned, and wept "I don't know where to go", "this sadness is stifling". Her voice was very low, without modulation; there was a strained, anxious expression on her face. She saw everything as though "in a fog"; nevertheless, she evaluated her surroundings and her condition correctly. She sought the sympathy of her physician but she asked him not to interrogate her and said she would tell him everything later. She was hypochondriacal, paid considerable attention to herself, was afraid of becoming sick with cancer and dying "before my children grow up". She had hallucinations, heard her mother's voice asking for a drink and calling her "Marusya!". She had a critical attitude toward her hallucinatory experiences; however, she avoided remaining alone in the ward, and was afraid to fall asleep because then "it is terrible". She saw her mother lying in the grave and alongside her there was "an empty grave" ready for her. Her mother was following her, calling to her, "clutching her dress". She expressed no delusions. She ate poorly, and food seemed tasteless.

Electric sleep treatment was given. Sleep inhibition of adequate depth was noted beginning with the second procedure:

she fell asleep after seven to 10 minutes. After the current was turned off sleep not uncommonly continued even after the procedure was over. The patient approved of this treatment, and said that with every procedure she was becoming "stronger", "more alert", "anxiety was leaving and everything was clearing up". She thought of the troubles she had experienced without her previous bitterness and grief.

After seven or eight electric sleep procedures the hallucinatory experiences disappeared; at night, she fell asleep without the use of hypnotics, but the nightmares were repeated from time to time. Afterwards, the patient became active, lively, her appearance changed. She occupied herself in handiwork, assisted the personnel, and prepared the ward for the performance of the routine electric sleep procedure. She told everybody that electric sleep "had brought her back to life". At the end of the course of treatment her night's sleep was completely restored, and the patient became stronger. In connection with a certain instability of her mood she was transferred to the sanatorium department, from where she was discharged to work.

Diagnosis: reactive state.

In the patient's history there are indications of a number of traumata which she had suffered: shell fragment wounds of the chest cage and soft tissues (in 1942), repeated abdominal operations for intestinal obstruction; head trauma with signs of cerebral concussion in 1949. It may be supposed that these injuries gradually weakened her nervous system and led to her nervous break (in 1951). Following treatment in a psychiatric hospital the patient was restored to health, and her working capacity returned; however, after a year (in 1952) severe psychic trauma again brought the patient into a state of decompensation.

The signs of depression and hallucinatory disorders of psychogenic nature predominated in the psychopathological picture of this disease--the patient heard the voice of her dead mother, saw her lying in the grave. The patient's pathological experiences were adequate to the situation and did not contain any delusional constructs. Despite the

severity of the condition she did not lose her critical judgment and perceived her experiences as pathological.

All this gives us the basis for regarding her disease as a reaction to severe psychic trauma colliding with a somewhat weakened nervous system. The great exhaustibility of the patient should be noted, attesting to the presence of protective processes of protective inhibition. The effects of the pulsating current intensified these processes, which also contributed to the very rapid emergence of the patient from her psychotic state.

In the given observation the connection between the effects of the pulsating current and recovery from the disease state is particularly distinct.

Patient K., age 29, accountant. She had been treated in the hospital of the Institute of Psychiatry from 11 February through 20 April 1955. She had been transferred from the Second City Hospital.

There were no mentally ill patients among her relatives, but when her mother was young she attempted to commit suicide following certain difficulties. The patient's older sister committed suicide at the age of 19 also following difficult personal experiences. In childhood she had been healthy; at the age of eight she started school. She completed seven years of school successfully, and began to work as a bookkeeper at the age of 17. Gradually she improved her qualifications at work, and in recent years she had been carrying out the duties of an accountant. She had been given prizes many times. In 1945, she suffered from typhoid fever with cerebral signs. Afterwards, she was treated on an outpatient basis for spastic colitis for a number of years. She began to menstruate at the age of 13, and menstruation was regular and painless. She had had no sexual experiences. By nature she was sociable, frank, but impressionable and anxious. In the summer of 1952 she made an attempt at suicide following quarrels with a man with whom she was in love. She promptly regretted her action, wept, sought forgiveness from her mother. She quickly forgot what had happened and continued to work. Beginning with

1953, the patient noted an increase in libido, attempted to get married, but did not find a man for this purpose. She became thoughtful, sluggish, "lost my joy of living". She ate poorly. She constantly looked at her face in the mirror and found that it was "becoming black and terrible"; afterwards, she began to have unpleasant sensations in her face: "pinching, pricking", and she saw how "the blood vessels are becoming prominent around the alae of the nose". Beginning with the fall of 1954 her sleep was disturbed, and her head was as though "in a fog", the unpleasant sensations in her face increased, and a feeling of burning in the chest was added to them. Her pathological experiences were so burdensome that the patient again had the idea of committing suicide. She fought with herself, "it was terrible to take one's life". However, on 9 February 1955 she, nevertheless, made a suicidal attempt--she took 20 grams of ratocide $\text{C}_{11}\text{H}_{10}\text{N}_2\text{S}$. She was hospitalized in the Second City Hospital. In connection with the fact that no dangerous signs were found in the internal organs the patient was transferred to our hospital after a consultation with the psychiatrist.

Objectively, the patient was somewhat infantile; she showed a marked loss of weight. The heart sounds were muffled. At the time of admission she had tenderness on palpation of the epigastric area and along the course of the large intestine.

On neurological examination no signs of organic involvement of the central nervous system were found. Blood and urine analyses were within normal limits. The blood Wasserman test was negative. On fluoroscopy of the chest organs no pathological changes were found. On fluoroscopy of the gastrointestinal tract it was shown that the descending portion of the colon and the sigmoid were spastic. On admission she was melancholic, covered her face with her hands, "I am so ashamed to look people in the eyes". She had "spoiled and disgraced her whole life". She offered a number of hypochondriacal complaints: burning in the stomach and intestine, which the patient associated with the ratocide intoxication. There was a feeling of "disconnection" in the chest. Her face was altered: "it became terrible".

and it blackened". She was troubled by unpleasant sensations of the nature of itching of the skin of the face, particularly near the nose. She had a constant feeling of "internal excitement", "head in a fog", her "joie de vivre had gone". Aside from inconstant ideas of guilt no other delusional interpretations could be found in the patient.

A course of electric sleep treatment was given (25 two-hour procedure) and general tonic therapy.

During the course of treatment the pathological sensations disappeared, she became lively, active, entertained the other patients with singing and stories. She wanted to live again. She made specific, very real plans, and spoke about this with satisfaction. Her intellect had not changed. The patient recovered and went to work.

Diagnosis: hypochondriacal syndrome in an emotionally unstable personality.

Here we have a patient with distinct personality characteristics, emotionally unstable, anxious, and impressionable who has a depressive reaction with a suicidal attempt in connection with a prolonged unfavorable situation. Apparently, a hereditary taint is of significance here: the presence of suicidal attempts in other members of the family (older sister of the patient committed suicide at the age of 19 because of difficult personal experiences). In our patient the depressive reaction passed quite rapidly; however, after a year the reactive hypochondriacal state gradually developed in which not the least part was played by somatic sensations associated with a suicidal attempt, with poisoning.

In this patient a diffuse inhibition which developed in electric sleep contributed to eliminating the foci of inert excitation produced by pathological interoceptive impulses as well as by static foci in the second signal system. It may be supposed that there was a blockage of the pathological interoceptive impulses passing through the hypothalamus. The area which, according to our concepts, is under the direct effect of the pulsating current.

Patient V., age 32, engineer was treated in the hospital of the Institute of Psychiatry from 10 February through 21 April 1951. He was admitted with complaints of persistent headaches, insomnia, and a sensation of "being tied up inside".

He came from a healthy family. He developed as a healthy child. He was good in school. He completed secondary school and was graduated from the Mining Academy. Married, had two children. In 1944 he had a head contusion in the front lines; however, he remained in the army until 1946. After demobilization he worked in his specialty. Beginning with September 1950 following certain unpleasant situations he began to stammer, felt "numb inside", became irritable, lachrymose, and experienced a certain anxiety, and could not work. For a long time he was treated on an outpatient basis, relaxed in a sanatorium but he did not regain his health.

Objectively, the patient was of normal build, and he showed signs of weight loss. There was vesicular respiration in the lungs; on percussion there was a clear pulmonary sound. The cardiac borders were not enlarged; the heart sounds were pure. Pulse was rhythmical and somewhat rapid, 78 beats a minute, and of satisfactory quality. The blood pressure was 120/65 millimeters. The abdominal organs were not abnormal.

Fluoroscopy of the chest showed the following: the lung fields were clear; the costophrenic sinuses were clear, and the diaphragm was mobile; the heart and aorta were normal and the pulsations were labile.

Blood analysis: hemoglobin 68 percent; white blood count 6200, eosinophils four percent, stabs two percent, segmented neutrophils 66 percent, lymphocytes 21 percent, monocytes seven percent. The blood Wassermann test was negative. The urine was normal.

The optic fundus was normal.

Nervous system: the cranial nerves showed no abnormali-

ties; the knee reflexes were obtainable from an expanded area; there were no pathological reflexes; there was a tremor of the fingers of the outstretched hands.

He had a mask-like face, and his gaze was directed into space. His voice was hoarse, quiet, and his speech was markedly retarded with frequent repetitions of individual syllables. He stopped speaking without finishing sentences, closed his eyes, and then again continued to speak in a hoarse monotonous voice. At times, his speech was accompanied by an unusual grimace. The patient explained his speech hesitations as "a stoppage of thought and movement". He complained of a feeling of being tied up inside: "as though I had been tied up and cannot break loose". He had visions: he saw pictures of "battles I have experienced", "terrible bloody bodies" on the wall. No delusions were elicited. In recollecting his traumatic experiences he shuddered and wept. He had a critical attitude toward his condition, and had a great desire to "be cured". In the hospital department he remained by himself, avoided socializing with the other patients, was melancholic and depressed. He ate poorly. His night's sleep was disturbed. He was drowsy during the daytime and sat in an armchair. He refused to go for a walk, because he was "ashamed" of his gait (he walked slowly, with small steps and frequent pauses; he bent forward on walking, his head dropped, and his hands remained at his sides).

Electric sleep treatment was given--20 two-hour procedures. As early as after the first three procedures changes were noted in the patient's condition. He became alert, stopped stammering, and spontaneously said: "look how well I speak". His general rigidity disappeared, and he returned with facility from his electric sleep procedures; "I walk with my usual gait". His positions were free and natural. His facial expressions became lively and adequate. Simultaneous with the motor disinhibition the patient noted "an elimination of the inner tightness". His thoughts came readily, and he wanted to talk about simple everyday things. Gradually, the nature of his hallucinatory experiences changed; he still "had visions", but there was nothing terrible or frightening in their content. The "visions"

appeared chiefly in the evening, when it was dark in the ward, and they were of the nature of illusory experiences: a spot on the wall appeared to be a pretty flower, etc. At the end of the course of treatment these signs also disappeared. His headaches disappeared. His sleep returned to normal. At the time of discharge he remained with instability of mood, and an increase in his affective reactions. He was discharged to "Sosvovyy Bor" Sanatorium.

Diagnosis: chronic reactive state after trauma.

In the history of this patient there is mention of head trauma, which did not cause any direct visible deterioration in his state of health, which permitted him to remain in the army and work productively in his specialty even after demobilization. However, following severe conflictual experiences distinct conditions of rigidity [the word literally means a welding together], functional speech disorders in the form of stammering and speech hesitations occurred. Psychogenic hallucinations were noted the content of which were traumatizing experiences of the more distant past at the front lines. The unusual feature of these psychogenic hallucinations was that the last traumatizing situation revived the inhibited traces of the difficult past experiences.

All the symptoms described speak for the presence of functional disturbances of the fundamental nerve processes. The elements of rigidity are apparently associated with inhibition of individual parts of the motor analyzer. Electric sleep, by deepening the protective inhibition, led to the normalization of the main nerve processes at first directly after the procedure and then for a longer time, which led to his emergence from the pathological condition.

Patient T., age 44, clerk, was treated in the hospital of the Institute of Psychiatry from 1 October through 9 November 1951. She was admitted with complaints of increased fatigability, irritability, headaches, melancholy, sleep disturbance and decrease in the ability to work.

She came from a healthy family. She developed normally. She had a secondary school education; by nature, she was

lively, sthenic and loved music. She began to work at the age of 23. She was married, had six pregnancies; of these two were interrupted by artificial abortion, and four terminated in delivery. One child is alive. Menstruation began at the age of 14 and was regular. In 1953, she suffered from typhoid fever; beginning with this time she had a cardiac valve defect. In 1942, she had a head contusion with prolonged loss of consciousness. Beginning with 1945 she began to have headaches, became irritable, and "lachrymose". In 1949, in connection with her increased nervousness she was treated in the sanatorium division of the Hospital imeni Z. P. Solov'yev. After discharge she felt satisfactory for a year. For the past six months she had worked considerably. Beginning with the summer of 1951 there was another deterioration in the state of her health; headaches appeared, feeling of weakness, and her working capacity decreased; the patient "forgot and confused everything", she had a feeling of "a constant internal strain".

Objectively, the patient was pale and showed signs of weight loss. There was vesicular breathing in the lungs; there was a clear pulmonary sound on percussion. The heart borders were enlarged to the left. A presystolic murmur was heard at the apex. The pulse was rhythmical and of satisfactory quality and accelerated (92 beats a minute), and labile. The blood pressure was 140/95 millimeters. The liver was two to three centimeters below the costal margin and was not tender. The spleen was not felt.

Fluoroscopy of the chest showed the following: the lung roots were prominent; the lung fields were clear; the costophrenic sinuses were clear, and the diaphragmatic function was normal. The heart showed the following: there was straightening of the cardiac "waist", the pulsations were weakened and labile. The aorta was normal.

Blood analysis: hemoglobin 62 percent, white blood count 5200, eosinophils six percent, stabs three percent, segmented neutrophils 58 percent, lymphocytes 28 percent, monocytes five percent. The blood Wassermann test was negative. The urine was within normal limits.

Nervous system: the optic fundus was normal; there was an oculostatic phenomenon, the tendon reflexes were increased equally, there was unsteadiness in the Romberg position; there was a tremor of the lids and of the fingers of the outstretched hands, and sweatiness.

The patient was sluggish, depressed, and in talking with the physician she cried: "everything hurts, everything is irritating"; she was fixed on her own pathological sensations. She paid considerable attention to herself, as to how her heart worked, and said, "something is occurring in my head". She asked that she be placed in a quieter ward "to give her rest". Her voice was quiet, she attempted to speak less; conversation fatigued her and increased her headache. She avoided socialization with other patients and lay in bed for the most part. She was readily excitable and showed an intolerance of noise. She reacted with tears to loud conversation, knocking, etc. She could not listen to the radio; music also irritated her. She ate poorly. Her night's sleep was interrupted, with moments of anxiety and nightmares. There were no delusions nor hallucinatory disorders. Her judgment was not impaired.

Electric sleep treatment was given (14 two-hour procedures). Under the influence of the current the patient fell asleep rapidly; sleep not uncommonly continued even after the current was turned off. After each procedure she noted "internal calming; the patients did not irritate her, and the hospital surroundings did not seem so tragic". She called these states "a clearing", because she began to feel worse again toward evening: "my head was filled with a weight", "I wanted quiet and rest". After seven or eight procedures her condition changed notably: the patient became more peaceful, collected, her headaches disappeared, and her night's sleep was restored to normal; she was affable with the other patients, was able to read and she played the piano for the other patients and tried to work. At the time of discharge her blood pressure was 120/80 millimeters. She was discharged and completed her electric sleep treatment on an outpatient basis. A month after discharge, she sent a letter to her physician in which she reported that she had become her "old self", and she praised the treatment

which had been given her.

Diagnosis: traumatic cerebraesthesia on a background of cardiovascular insufficiency.

This observation is similar to the preceding one. Here also the initial etiologic factor was a head contusion. Afterwards, cerebraesthetic symptoms began to develop gradually: headaches, increased affective reactions and fatigability, in connection with which the patient was treated in the Hospital imeni Z. P. Solov'yev in 1949. In 1951, after strenuous work, which proved to be too much for the patient, a new episode of decompensation occurred with a revival of the symptoms which had been observed previously. The patient was depressed, asthenic, headaches troubled her, and she had insomnia and loss of appetite.

The application of electric sleep proved to be affective here also: her headaches disappeared, her night's sleep became normal, and her working capacity was restored.

Patient N., age 55, merchant, was in the hospital of the Institute of Psychiatry from 27 April through 18 June 1954.

For her history see page 53.

From the patient's history it follows that a prolonged (for a year) conflictual situation at work preceded the development of her psychotic condition, in connection with which she worried a great deal and, at the same time, worked in an intense and strenuous fashion; all this led to a weakening of her nervous system. A new acute psychic trauma acted on this weakened background--her only daughter was married in spite of the wishes and advice of her mother, abruptly breaking away from her.

The characteristic feature of this clinical observation consists in the fact that all the psychic traumata mentioned were suffered by the patient during the involutional period, at which time she also developed signs of vascular incompetency--her blood pressure at the time of admission to the hospital ranged within limits of 190/110--160/110 milli-

meters. Signs of profound depression predominated in the psychopathological picture of the disease; however, the structure of the depressive syndrome itself did not contain any features of involuntional melancholia. The patient's experiences were simple, comprehensible, and reflected the actual situation.

Electric sleep treatment proved to be effective, and the patient came out of her state of depression during the course of therapy. The fact deserves attention also that in this patient there was a hypotensive effect of the pulsating current observed--the arterial pressure at the end of the course of treatment dropped to normal (130/80 millimeters).

Patient A., age 39, scientific worker, was in the hospital of the Institute of Psychiatry from 8 through 27 June 1953. She was admitted with complaints of melancholy, loss of sleep, weakness, and an inability to work.

She came from a healthy family. Developed normally. She successfully completed secondary school and was graduated from the mechanics-mathematics faculty of the Moscow State University. She worked as an aerodynamic engineer and simultaneously did work for her candidate's degree at the Institute of Mechanics. In 1947, she defended her candidate's dissertation. She married in 1939. Her family life was happy. She was always energetic, active and self-restrained. "I loved life very much", and "was a very happy student". She first came to the psychiatrist in 1947 following the death of her father. At that time she became melancholic--"life lost all its meaning". For a year she did not work, did not leave the house, lay in bed, could not eat--"food was disgusting". Gradually, her condition improved, she returned to work; however, the feeling of "an internal emptiness" remained and at times "she became melancholic again". She looked for means of filling in the "breach". She wanted to have a child, hoping that it would distract her from her painful recollections. In 1952, she became pregnant; at that time a fibroma of the uterus was diagnosed by the gynecologist. In the summer of 1952 she was operated. Before the operation she worried a great deal, fearing that the operation for removal of the fibroma

would disturb her pregnancy. The pregnancy was preserved, but delivery was accomplished by Caesarian section by virtue of the transverse position of the fetus. After three days, the child died. Again she became melancholic, life was without any meaning, she wanted to die, sought means of taking her life, could not sleep, and refused to eat.

Objective observation: there were definite signs of weight loss; there was pallor of the skin. Lungs: there was a clear percussion note; the breathing was vesicular. The borders of relative cardiac dullness--on the left was at the mid-clavicular line; on the right--at the right margin of the sternum. The heart sounds were pure and somewhat increased. The pulse was rhythmical and of satisfactory quality. The blood pressure was 120/70 millimeters. The liver and spleen were not enlarged.

Fluoroscopy of the chest organs showed the following: the lung roots were prominent with dense lymph nodes; the lung fields were clear; the diaphragmatic function was normal. Heart--left ventricle was possibly enlarged, the pulsations were labile, and the aorta was normal.

At the time of admission the blood analysis showed the following: hemoglobin 55 percent, red blood count 3,800,000, white blood count 4,000, basophiles one percent, eosinophils two percent, stabs three percent, segmented neutrophils 42 percent, lymphocytes 45 percent, monocytes seven percent; sedimentation rate six millimeters in an hour. The blood Wassermann test was negative. The urine was within normal limits.

Nervous system: the cranial nerves showed no apparent changes; the tendon reflexes were increased equally; there was a tremor of the lids and of the fingers of the out-stretched hands, and there was a striking play of the blood vessels.

At the time of admission and for the initial period of her stay in the hospital she was melancholic, had an expression of suffering on her face, her speech was whispered, she wept, did not believe in the possibility of recovery--"there

is no cure for misfortune". She asked that the physicians refrain from interrogating her concerning "her sick places"; however, she herself began to relate her traumatizing experiences in detail. She had not become accustomed to her misfortune--the loss of her father, who was a friend and guide in her life, hoping that the birth of a child might aid in "rerouting her and letting her forget" and this hope had been lost. There was no future for her, "everything is enveloped in gloom". It would be better to quit this life, because there was no strength "to regain her will and dispel her melancholy". Everything irritated her, she had a lack of confidence in everything, "everything is difficult". No hallucinatory disorders or delusions could be elicited. Her intellect was preserved. She was completely accessible, adequate, sweet-tempered and affable with the other patients.

Electric sleep treatment was given (duration of the procedures was three hours) with a total course of 15 procedures, and general tonic therapy (glucose and polyvitamin infusions). Her condition in the electric sleep procedures could be characterized as transitional between waking and sleeping. The patient herself said that she "forgot" and could not say how long the procedure lasted. After the procedure she noted a feeling of freshness, and spontaneously went to the dining room for dinner; not uncommonly, she was drowsy during the hours of after-dinner relaxation, but at first her night's sleep continued to be disturbed. The sharpness of her traumatizing experiences lessened, and the patient became noticeably more calm, collected, and had the desire to live. She was troubled by the hospital atmosphere, which reminded her of "the other hospital where I lost my child".

At the time of discharge she had become stronger physically, gained about three kilograms in weight. Her night's sleep was returned to normal. Analysis of the blood showed the following: hemoglobin 67 percent, red blood count 4,200,000, white blood count 4,900, eosinophils two percent, stab four percent, segmented neutrophils 57 percent, lymphocytes 31 percent, monocytes six percent; sedimentation rate six millimeters in an hour.

She was discharged in a state of considerable improvement and was given a therapeutic vacation from work.

Diagnosis: chronic reactive depression on an asthenic background.

The patient was active, energetic, had always loved life, showed her first psychotic reaction in 1947 upon the death of her father and very slowly and gradually emerged from her pathological condition. In May 1953 she had another severe psychic trauma--the death of her child--which was a new high-powered stimulus, which led to a nervous break with a revival of the inhibited traces of her first psychic trauma.

The characteristics of the observation being analyzed consist of this, that the second psychic trauma acted on a somatically weakened soil (operation of removal of a fibroma and delivery by Caesarian section). These factors aggravated the patient's condition still further.

On clinical examination the definite signs of vegetative insufficiency attracted attention (increase in reflex excitability, play of the blood vessels, tremor of the lids and fingers). The patient was depressed, adynamic, and had become extremely asthenic.

The application of electric sleep proved to be quite effective. Electric sleep deepened the protective inhibition, by the same token contributing to the recovery of the principal nerve processes.

Patient K., age 22, draftsman, was in the hospital of the Institute of Psychiatry from 28 February through 26 March 1952. She was admitted with complaints of melancholy, insomnia, and headache.

She was the only child in the family and developed normally. In childhood she had no sicknesses. She began to menstruate at the age of 15 and was regular. Her progress in school was average. She completed seven years of school and worked as a draftsman-tracer; in the past year she car-

ried out the duties of a technician, although she had no special education. She coped with her work successfully. She was married and had a child. From childhood she had been happy, "a hearty laugh", but "sensitive", inclined toward dreaminess. She had never been treated for nervousness before.

The present illness began after the patient had been for a long time in a conflictual situation which traumatized her. Her sleep was disturbed, her working capacity decreased, she began to be melancholic and had suicidal ideas. The day before being put in the hospital she made a suicidal attempt.

Objectively: the patient was of medium height, normal body build, and well nourished. There was vesicular breathing in the lungs. The heart sounds were pure, and the heart borders were within normal limits. The pulse was rhythmical and of satisfactory quality. The blood pressure at the time of admission was 115/75 millimeters; at the time of discharge, 127/70 millimeters. The abdominal organs were not abnormal.

Fluoroscopy of the chest cage organs: lung fields were clear, the diaphragm was mobile, the costophrenic sinuses were clear; the lung roots were accentuated with calcified lymph nodes; the heart was within normal limits for her age in size and shape, and the pulsations were labile.

Blood analysis at the time of admission showed the following: hemoglobin 76 percent, white blood count 6,000, eosinophils one percent, stabs one percent, segmented neutrophils 68 percent, lymphocytes 26 percent, monocytes four percent; the sedimentation rate was four millimeters in an hour. The blood Wassermann test was negative. The urine analysis was normal.

On neurological examination an increase was noted in the tendon reflexes, acrocyanosis, sweatiness, and a tremor of the fingers.

During the initial period of her stay in the hospital the patient was melancholic, extremely emotional, unstable, showed sudden marked changes from crying to being lively.

She was accessible, sought sympathy and aid; she described her pathological experiences vividly and picturesquely: "here melancholy wells up from within, I become sensitive and want to cry and cry". During periods of exacerbation of her melancholy there were inconstant delusional statements: she was "a sinner, tormented everybody: at home--her daughter, although she loved her more than life itself; here--all the patients and all the physicians". It wasn't necessary to live, it wasn't worth it; she was treated worse than the others, she wanted to be alone and not to see anyone. She had hallucinatory experiences of the nature of illusions: she perceived spots on the ceiling as "shadows of dead persons in Hell"; they "all came together and floated in the air"; at the same time, she heard melodies from "Francesca da Rimini", specifically those which reflected "the torturing of the sinners in Hell". The hallucinatory disorders were increased at night time, in connection with which her night's sleep was disturbed.

Electric sleep treatment was given in combination with small doses of insulin. In all, 15 electric sleep procedures were given lasting for four hours. The dose of insulin did not exceed 10 units a day.

The patient slept deeply under the influence of the current, and sometimes she had dreams, "simple, ordinary ones", as she characterized them herself. After the procedure she became more calm, each time noting that it was easier for her "after the current". She compared her condition following electric sleep with the condition of a woman who had just had a baby. Her state of melancholy passed, "offensive thoughts did not come into my head", she was relaxed, free, and wanted "something to do".

At the end of the course of treatment she had an even, calm disposition, she was completely collected, active in her socialization with those around, occupied herself with handiwork, made adequate plans for the future, and had a critical attitude toward the pathological condition which she had had. The signs of vegetative insufficiency noted at the time of admission were less pronounced at the time of discharge. Her night's sleep was completely recovered.

Diagnosis: reactive state in an unstable personality.

The patient had been examined in the laboratory of higher nervous activity by the method of speech reinforcement. She formed a conditioned association and differentiation and consolidated them beginning with the second combination. A simple dynamic stereotype was elaborated without any particular difficulty. The insignificant strength of the motor conditioned reaction, which became even weaker at the end of the examination, as well as the prolonged latent periods attracted attention; all this attested to the exhaustibility of the stimulatory process. Revision of the stereotype before treatment proved to be a task which was too much for the patient. She refused to "occupy herself", wept, and stated that she didn't understand anything, and called herself "a sinner", and asked that she be allowed to go home.

At the end of the course of treatment, when a considerable improvement was noted clinically in the patient's condition, her attitude toward the laboratory investigation changed. She came to the laboratory calmly, occupied herself eagerly, and she herself noted that now "everything was working out well for her". She accomplished the revision of the stereotype and the substitution of conditioned stimuli in the stereotype by their verbal designations without difficulty. Along with the adequate and rapid solution of the tasks which were set before her by the examination an adequate magnitude of the reaction was noted with a simultaneous reduction in the latent period, which made it possible to speak of adequate mobility, strength and balance of the stimulatory and inhibitory processes as well as of the presence of selective irradiation of the stimulatory and inhibitory processes from the first to the second signal system.

From the history it is known that the patient had always been distinguished by dreaminess, a tendency toward fantasy, was sensitive, vulnerable, and this made it possible, with a certain degree of probability, to consider her type of nervous system as similar to the artistic type.

As the result of a prolonged traumatizing situation, a

prolonged fight to overcome the difficulties encountered, a reactive psychotic condition developed in the patient according to the mechanism of conflict: melancholy, ideas of guilt and reference, hallucinatory experiences with a psychogenic coloring: she "saw the souls of the sinners", she simultaneously heard the motifs from "Francesca da Rimini" which reflected the torturing of sinners in Hell. She made a suicidal attempt. However, even at the height of her psychotic outbreak she remained accessible, simple and understandable. She admitted readily to psychotherapeutic procedures. Her hallucinatory experiences were topical. Her delusion did not show any tendency to become generalized, and under the influence of treatment it very quickly disappeared. All this gave us the grounds for diagnosing this condition as a reactive state in an unstable personality.

The data of examinations of the neurodynamics of the patient during the acute period before treatment did not show any gross disturbances in the dynamics of the fundamental nerve processes. We observed a decrease in the magnitude of the reaction and an increase in the latent period, which indicated an increased degree of fatigability of the cortical cells and developing signs of protective inhibition. Therefore, the use of electric sleep treatment in this patient was completely justifiable. By deepening the phenomena of protective inhibition through the effects of the pulsating current, we, by the same token, also contributed to a recovery and normalization of the nerve processes, which, in its turn, was manifested clinically in complete recovery.

Treatment of reactive states under conditions of a legal psychiatric hospital, where there has been a prolonged effect of the psychogenic factor, is of considerable interest and is of important practical significance.

A. K. Dobrzhanskaya in the Institute of Legal Psychiatry imeni Serbskiy used electric sleep treatment along with other methods of therapy of reactive states basically for patients with reactive depression and in the reactive stuporous states. In patients with various manifestations of

reactive depression sleep inhibition without a therapeutic procedure did not achieve adequate "intensity or extent", as is the case with normal sleep, and because drug-induced sleep did not always produce the desired effect, A. K. Dobrzhanskaya used electric sleep treatment for intensifying the phenomena of protective inhibition.

The patients slept particularly well beginning with the second procedure, falling asleep 10-15 minutes after the current was turned on and waking up one and sometimes two hours after it was turned off. Therefore, in the great majority of patients a transition of the phase of electric sleep into natural sleep was observed. The duration of sleep in certain patients during the first few days of treatment reached $4\frac{1}{2}$ hours; as a rule, the night's sleep also became normal. At the time of the first procedure certain patients with reactive depression woke up in tears, and stated that something terrible was happening to them, "they had become even more melancholic"; on subsequent days of treatment the sleep was calm. After each electric sleep procedure the patients spoke of an improvement in the feeling of well being, particularly during the first few hours after waking up; they used the following words for characterizing their condition: "there is no heart-ache, no melancholy, everything is free and easy"; "my thoughts don't trouble me always about the same thing", "things have cleared up in my head", "I feel as I did before becoming sick".

The degree of cure was different. In certain patients the pathological symptomatology gradually disappeared, the disposition became even, the behavior in the hospital department was more active, and the patients began to eat spontaneously where they had to be fed prior to this. The edge was taken off the melancholy and tension, and the patients began to show interest in their surroundings and became more accessible. Practical recovery occurred after an indistinctly expressed period of general asthenia.

In others it was possible to observe a change in the fundamental symptoms of the depressed state under the influence of treatment: where at the beginning the depressive reaction progressed against a background of general inhibition and

retardation of all the mental reactions, during the course of treatment this picture of depression changed--anxiety, fear, confusion, restlessness increased, and the patients constantly sought the physician for help, "to save" them, and spoke considerably and in detail concerning the traumatizing situation. However, the depth of the depressed state here became less: the patients became more active and along with the complaints of their condition, with their tears, and their pleas for aid, included themselves in the life of the department and fought for their interests. Gradually, this condition of excitation disappeared and was replaced by signs of asthenia with subsequent recovery.

Certain patients (very few) did not sleep during the electric sleep procedure; however, regardless of this they noted an improvement in their condition after each procedure, which was reflected also in the data of the laboratory examinations. Electric sleep treatment sometimes proved to be effective when drug-induced sleep had made no essential changes in the course of the disease.

S., age 54, was accused of theft.

At the age of 21 he had suffered from syphilis, took several courses of treatment, and in subsequent years felt good. The present disease developed promptly after his trial: the patient became sad, depressed, answered questions reluctantly and slept poorly. On examination the following were established: pulse, 100 beats a minute, satisfactory quality; blood pressure 130/75 millimeters. Internal organs and nervous system showed no abnormalities.

Mental condition: the patient was sad, depressed, inhibited, answered questions laconically, with single words; his movements were retarded, his facial expression was mournful, and there were tears in his eyes. He complained of a melancholy disposition, a lack of desire to live, indifference to everything. He was very much dejected by the circumstances of the trial, complained of what had happened, telling the whole story, and began to cry bitterly. In the department he submitted to nursing care passively, had no requests to make, and did not socialize with those around.

He was sent to the workshop, did nothing there, sat, putting his head in his hands, and wept.

Prolonged drug-induced sleep treatment was given for 26 days; however, no essential changes occurred in the patient's condition: he remained melancholic, depressed, inhibited, and lay the whole time in bed. In connection with the failure of the drug-induced sleep electric sleep treatment was begun for the patient. In all, he was treated with eight procedures. During the effect of the pulsating current he slept well, and woke up usually one half to one hour after the apparatus was turned off. Beginning with the first day he noted that he was less troubled by headaches; on subsequent days his disposition became even, and his night's sleep became normal. The patient took the procedures very eagerly; after each electric sleep procedure he said that he "felt alert and of better disposition", and he participated enthusiastically in the work processes.

He was discharged in good condition with the following conclusion: "he had suffered a reactive state (reactive depression)".

It is interesting to note that cure of the pathological condition is somewhat different for drug-induced sleep treatment and for electric sleep treatment. While the improvement in the patients' conditions in drug-induced sleep treatment occurs gradually over a month or more and the period of asthenia is pronounced, in electric sleep it proceeds much more quickly and sometimes one may speak of recovery of the patient as early as after 10-15 days of treatment. This has been confirmed in the comparative data of the neurodynamics and in the biochemical research carried out by A. K. Dobrzharskaya.

A comparison of the results of laboratory examinations and the treatment by drug-induced sleep and electric sleep are of interest in the same patients, as is also a comparison of the results of laboratory examinations in electric sleep with the results which were obtained after treatment by drug-induced sleep in various patients.

Conditioned reflex activity is recovered sooner with electric sleep treatment. In the first few days after the treatment new conditioned associations are elaborated in certain patients by the second or third combination, the magnitude of them is equal, the latent period is 0.1-one second. No phasic states are found, the stereotype can be elaborated and revised readily; in the case of drug-induced sleep this presents difficulties initially after the treatment. The fasting blood sugar increases to a greater degree and more quickly after electric sleep therapy than in drug-induced sleep, and the process of glycogen formation (vago-insular phase of carbohydrate metabolism) is improved. Pyruvic acid shows greater changes in the direction of an increase in it (up to 3.8 milligrams percent) from its intermediate products in the absence of any reduction in the concentration of lactic acid (12 milligrams percent), although sometimes its concentration increases (to 15.6-20.5 milligrams percent).

The data presented show a definite normalization of the carbohydrate metabolism which occurs more rapidly after electric sleep treatment than after drug-induced sleep.

In investigating the changes in nitrogen metabolism under the influence of electric sleep treatment it was possible to note a tendency toward normalization of the nonprotein nitrogen, but a change in the albumin-globulin ratio was observed in the direction of a decrease in it because of the increase in the globulin fraction, which speaks for changes in metabolism occurring under the influence of electric sleep.

3. Schizophrenia

The problems of treating schizophrenia remain exceptionally important at the present time. The old period of therapeutic nihilism with respect to schizophrenia was replaced in the 1930's-1940's by a period of excessive captivation by so-called "active methods of treatment": Treatment with continuous pharmacologic sleep, insulin shock therapy, convulsive therapy and, finally, leukotomy. Soviet psychia-

trists had a critical attitude toward the method of leukotomy. Under the leadership of V. A. Gilyarovskiy considerable work was undertaken on the analysis of catamnestic data in the patients who have had the operation of leukotomy, which caused this method to be dropped. In recent years, foreign authors, taking into consideration the intractable disturbances brought about by leukotomy, are also rejecting it.

The research of A. Baryuk has shown that both convulsive and insulin shock therapy lead to disturbances in the cerebral circulation. He considers these methods of treatment symptomatic and imperfect, because each of them leaves an organic cerebral defect. Naturally, based on the teaching of I. P. Pavlov concerning protective inhibition, Soviet psychiatrists have sought milder methods, like fractional pharmacological sleep, conditioned reflex sleep, and different variants for prolonging and deepening natural sleep.

We consider the electric sleep method which we have proposed one of the methods of deepening protective inhibitions.

I. P. Pavlov believed that schizophrenia in certain of its variations and phases actually represent chronic hypnosis. He saw the basis of this hypnosis in a weakness of the nervous system, especially of cortical cells: "...On meeting with difficulties such a nervous system, most often during the critical physiological and social-life periods, goes into a state of exhaustion inevitably after too much excitation. Exhaustion is one of the most important impulses for the occurrence of an inhibitory process as a protective process". (I. P. Pavlov, "Complete Collection of Works", published by the Academy of Sciences USSR, 1949, volume III, page 410).

I. P. Pavlov saw the basis of the favorable effect of sleep in a deepening of the developing protective inhibition, which creates conditions for rest of the exhausted cortical cells and for the recovery of their working capacity. These theoretical principles underlay the sleep treatment of schizophrenia.

A. G. Ivanov-Smolenskiy came to the conclusion on the basis of his clinical observations that a prolongation of physiological sleep through narcotic agents is more effective than continuous sleep lasting 10-12 days. For the purpose of reducing the toxic effect of the narcotic agents their dosage was reduced, and conditioned reflex mechanisms were utilized; for the purpose of creating the most favorable conditions contributing to sleep complete quiet was provided in the ward, the blinds were closed over the windows, and weak monotonous rhythmical stimuli were administered--the beat of a metronome and a slowly blinking blue light. However, the toxic effect of pharmacologic hypnotics can not be completely eliminated even with the use of minimal doses, whereas electric sleep is distinguished by the complete absence of any toxic effect.

Based on the Pavlovian inhibitory theory of schizophrenia we used electric sleep in those conditions where there were signs of protective inhibition in the clinical picture. However, practice has shown that in patients in a catatonic stupor the psychotic state is not eliminated under the influence of the pulsating current. In this group of patients we most often observed a transformation of the syndrome: The catatonic stupor was replaced by hallucinatory-delusional excitation, and sometimes hebephrenic features were found in their behavior. It may be supposed that the use of a pulsating current eliminates motor inhibition in these patients and exposes the hallucinatory-paranoid symptoms which had been latent before this. We observed more favorable results in the hallucinatory-delusional syndromes, particularly in new cases, where neurotic onlays occupied an important place in the clinical picture.

Our observations deal with 100 schizophrenic patients chiefly in the hallucinatory-paranoid form. The fact attracts attention that we obtained the best results in patients in whom the onset of psychosis was associated with the presence of an acute or prolonged state of psychic traumatization.

During the course of treatment with electric sleep a distinct calming of the patients occurred. First of all,

the neurotic onlays were eliminated, and the night's sleep and general conditions of the patients gradually improved. We also succeeded in observing the disappearance of psychotic symptoms. The hallucinatory experiences gradually disappeared and a critical attitude appeared with respect to the previous delusional experiences. Improvement did not occur immediately but rather in a wave form; sometimes, directly after the electric sleep procedure we observed a complete elimination of psychotic symptoms, although initially this condition was not lasting and a recurrence of the previous hallucinatory-delusional experiences was frequently observed. Only after a course of treatment (20-25 procedures) did we obtain a more lasting therapeutic effect. In certain patients there was no complete recovery from the psychotic state, but an alleviation of individual symptoms was observed, which made it possible to discharge the patient home.

A much less favorable effect was observed in the hypochondriacal type of schizophrenia. In the new cases we succeeded in obtaining a good remission with a return to work. In cases where the disease had been of long duration we did not observe any improvement in the patients' conditions, but sometimes even observed an exacerbation of the hypochondriacal experiences.

I. P. Pavlov ascribed considerable importance to the patient's surroundings in psychiatric hospitals, which should provide the maximum rest for the patients. In accordance with these principles a psychiatric hospital was organized in his laboratories. The surroundings in the hospital directed by V. P. Protopopov, who was one of the first to rearrange its entire routine on the basis of the principles of protective therapy, is in accordance with these principles. The mildness of the effect used in electric sleep is also in agreement with the principles of protective therapy.

Below, we are presenting a number of clinical observations of the use of electric sleep in schizophrenia. Along with examples of the favorable effect, observations of the patients are presented in whom electric sleep did not produce improvement, but it is seen on analysis of the dynamics of their psychopathological conditions that throughout the

course of treatment the individual disease symptoms improved notably and were altered. These observations are also valuable for the purpose of elucidating the mechanism of action of electric sleep.

Patient V., age 26, housewife, was in the hospital of the Institute of Psychiatry from 11 September through 3 November 1952.

Her parents had died when she was a child. She had been brought up in her grandfather's family. There were no mental patients among her relatives. In childhood she had frequently been sick. She began to menstruate at the age of 15, and her menstruation was regular. She had always been impressionable, touchy, reserved and "quiet". She liked to be alone and avoided her acquaintances. She completed seven years of school. She began to work early as an assistant worker at a factory. She married at the age of 20. She had two pregnancies which terminated in deliveries. She had a daughter aged five and a son aged three. The family relationships were good.

Her disease began in 1951: She began to be sluggish, "helpless", and had headaches. She gradually developed delusional ideas of reference, and complained to her husband that everybody was laughing at her at work, "they were writing letters with hints about something". In connection with this, she left work. She occupied herself only with her house work, but even at home everything seemed strange. Her husband's brother "looked at her peculiarly", and "was practicing witchcraft". Her melancholy and aloofness increased. The patient wept continuously, food was "disgusting" to her. She could not sleep. She neglected her house work. She stated that she couldn't do anything now, because she had been "bewitched". Her attitude toward her children changed, and she stopped being concerned about them. She said that they had become strangers to her. Afterwards, an acute psychotic condition developed: Motor and speech excitation with aggressive tendencies and with an exacerbation of her hallucinatory experiences. She was hospitalized.

Objectively, a pallor of the skin was noted. She showed

signs of loss of weight. She had vesicular breathing in her lungs; on percussion there was a clear pulmonary note. The borders of relative cardiac dullness were within normal limits. Her heart sounds were pure and increased. The pulse was rhythmical and of satisfactory quality. The blood pressure was 110/55 mm. There were no changes in the abdominal organs.

Fluoroscopy of the chest cage showed the following: The lung fields were clear, the costophrenic sinuses were clear, and the diaphragm was freely movable. Heart: Left ventricle was insignificantly enlarged. The aorta was normal.

At the time of admission the blood analysis showed the following: Hemoglobin 63 percent; white blood count 5000; eosinophils one percent; stabs four percent, segmented neutrophils 58 percent, lymphocytes 32 percent, monocytes five percent; sedimentation rate 8 millimeters in an hour. The blood Wassermann test was negative. The urine analysis was normal.

The examination of the nervous system showed the following: The pupils were of normal shape and reacted in a lively manner to light and on convergence; there were no oculomotor disturbances; the other cranial nerves were normal; the tendon reflexes were lively and equal; there was sweatiness and acrocyanosis.

On admission to the hospital the motor excitation had been replaced by depression and melancholy. Her speech was whispered; she answered questions after long delays and with single syllables. She called herself "bewitched". She complained of a feeling of burning throughout her body and in her head, and she gave a delusional interpretation of her pathological sensations: She had been "poisoned". Her night's sleep was disturbed, she was afraid to fall asleep, because she was afraid that during her sleep the harmful "bewitching" actions "directed against her" would increase still further.

Electric sleep treatment was given (prolonged routines,

18 procedures). Sleep inhibition of adequate depth developed in the second procedure. The patient slept peacefully for 3½ hours. She noted that after the treatment things "became easier" for her, and "there was no tightness in her chest". At subsequent electric sleep procedures she also fell asleep quickly. Sleep not uncommonly even after the current had been turned off.

The first symptoms of incipient improvement were the following: recovery of night's sleep and a change in her disposition immediately after the therapeutic procedure, at which time she became more calm, showed interest in those around, spoke with the other patients, and went for a walk. In the words of the patient, after electric sleep she "forgot her bewitchment". At the end of the course of treatment her hallucinatory experiences disappeared, she expressed no delusions, but she was not completely critical of the pathological experiences which she had had. She wanted to go home, was troubled, and was lonesome for her children. She was discharged home in a condition of considerable improvement.

Diagnosis: Schizophrenia, hallucinatory-paranoid type.

The patient was examined in the laboratory of higher nervous activity according to the method of speech reinforcement.

Before electric sleep treatment weakness was noted in the associative function of the cerebral cortex; conditioned reflexes were formed only in the 37th combination and were consolidated in the 46th. At the end of the examination a prolongation of the latent period and a decrease in the strength of the reaction were noted every time. Differentiation could be elaborated, but it could not be consolidated before treatment.

The examinations in the laboratory were continued after the seventh electric sleep procedure. Differentiation was consolidated, and a simple dynamic stereotype was formed and consolidated. A certain exhaustibility of the stimulatory process was noted: a decrease in the magnitude of the

reaction at the end of the examination and prolonged latent periods.

At the end of the course of treatment the direct conditioned stimuli in the stereotype could be replaced by their verbal designations (without difficulty). The patient's verbal report made it possible to be sure of the existence of selective irradiation of the stimulatory and inhibitory processes from the first signal system to the second.

After the conclusion of the course of electric sleep treatment the revision of the stereotype was made, whereby the patient showed complete adequacy in her conditioned motor reactions.

An analysis of this observation shows that the disease developed gradually, over the course of a year. The chief symptoms were ideas of reference, a change in the emotional state. On the basis of delusional motives the patient stopped work; however, her hallucinatory disorders (olfactory hallucinations) occurred even under domestic conditions. Later, an acute psychotic state developed with motor and speech excitation. The development and course of the disease and its main psychopathological symptoms, delirium and hallucinations--make it possible to speak of the hallucinatory-paranoid type of schizophrenia.

Before electric sleep treatment definite disturbances were noted in the neurodynamics of higher nervous activity; it was impossible to form a conditioned reflex, which spoke for the disturbance in the associative activity of the cortex. The clinical picture of this period of the disease was characterized by delusions and hallucinatory disorders against a background of reticence and melancholy. During the course of electric sleep treatment psychopathological disturbances gradually lessened, whereby the first clinical features of the improvement were noted beginning with the seventh electric sleep procedure. At that time, as examinations of higher nervous activity showed, we observed a recovery of the associative function of the cerebral cortex. The disturbances in the interaction of the signal systems were eliminated. Normalization of higher nervous activity

was associated with the clinical picture of a remission in the patient, which occurred at the end of the electric sleep treatment.

Patient K., born 1924, a silk twister, was in the hospital of the Institute of Psychiatry from 18 October through 11 December 1955.

She came from a healthy family. She was the third child. She grew up to be a lively imaginative girl. She completed seven years of school, was a good student, but she was unable to continue her studies on account of the War. She worked in a watchmaker's shop, and had obtained the title of "expert". Beginning with 1946 she worked as a silk twister at the Stakhanovka Factory, and had been awarded prizes repeatedly. By nature, she was energetic, participated actively in the life of the factory.

Her personal life was unhappy. In 1945, she was married. Her husband turned out to be an alcoholic and left her. Once, he had given her serious bruises, and "had kicked her in the stomach". In the words of the patient, a diagnosis of "intestinal tears" had been made. For about a month she lay in bed at home under the surgeon's observation. She denied any other serious somatic diseases in her history. She began to menstruate at the age of 14 and was regular. She had one pregnancy which terminated in delivery. She had a daughter aged 10. The patient had left her husband and was living in her mother's family.

The present illness developed gradually, beginning with August 1955, after acute psychic trauma. Since childhood the patient had had a friend whom she had at one time considered to be her fiancé. She was very much attached to the mother of this man. In August 1955 her friend's mother died. She took this death grievously. She believed that she had lost someone very close to her. She wept a great deal, lost sleep and appetite, and considerable weight. In the first half of October 1955 she had a sore throat, with a temperature of about 40° for several days; she had vomiting. After her return to work she felt exhausted, weak, could not eat, lost sleep, "did not want to either speak or

work". She felt the presence of the dead mother of her friend, heard the rustle of her dress, saw her silhouette in the shop between the work benches. Afterwards, her behavior became inappropriate, "she dressed to go to work as though she would be going to the theatre", she could not work, became sluggish, refused to eat, and did not speak.

At the time of admission, she had lost considerable weight. Her skin was pale. The mucous membranes of her lips had a cyanotic tinge. The borders of her heart were enlarged to the left. The second heart sound over the pulmonary artery was accentuated. Her blood pressure was 115/70 millimeters. She had a dry coated tongue. Her thyroid gland was somewhat enlarged.

On neurological examination no signs of organic involvement of the central nervous system were found. Her palms were moist, there was a tremor of her lids and the fingers of her outstretched hands.

The blood Wassermann test was negative. At the time of admission her hemogram showed an insignificant shift to the right. Her urine was normal.

At the beginning of her stay in the hospital the patient was melancholy, confused, had an expression of suffering on her face; she looked at her physician for a long time in silence. She did not reveal her pathological experiences right away. Her voice was hoarse, quiet, and without modulation. All her movements were markedly retarded. She complained of "complete impotence" and of a "torturing" headache. She asked that people speak with her in a whisper because any loud sound and even ordinary speech "was deafening", and she could not understand it. She hallucinated, smelled a cadaveric odor, heard the rustle of the dead woman's dress, and felt her presence. She had nightmares: "Crosses, and graves, and she saw the dead person lying in the tomb", "but she was alive". She had an insuperable desire to go to the cemetery, dig up the grave, and see what she was doing there". Afterwards, she had delusions along with a profusion of hallucinatory experiences: They were laughing at her, everybody looked at her "pecu-

liarily". She spoke of the presence of "an alien force" in her, which was causing her to think "of evil, of the frightening, of the unknown", "the thoughts were crawling about and rambling". She was entirely immersed in her pathological experiences, did not socialize with those around her; she stayed in bed all the time, lay without moving and with her eyes closed. Before treatment she ate very little, refused to eat, because "the food had a cadaveric odor". She vomited after eating. Her night's sleep was disturbed, and she fell asleep about two or three o'clock in the morning.

She was given a course of electric sleep treatments (25 two-hour procedures) in combination with insulin (14 injections). Even during the process of treatment the patient emerged from her pathological state.

She began to fall asleep even with the very first electric sleep procedure, and she slept even after the current was turned off. She awakened alert, her general inhibition was lost for several hours, and her speech was loud and confident. The patient smiled, said that "now things were not terrible for her". She went to the dining room, and she ate independently. However, toward evening she again became melancholic, retarded, looked fixedly into the poorly lighted corridor and listened.

After eight to 10 electric sleep procedures her hallucinatory experiences disappeared: At first, they "became distant", in the patient's expression, and then, disappeared altogether. She began to socialize with the other patients, went for walks, but continued to complain that she "was not herself", "that she had incomprehensible thoughts". She could not read, because she was unable to assimilate what she read.

At the end of the course of treatment her delusions and the signs of psychic automatism disappeared. The patient became lively, cooperative, participated actively in the work, was attentive to her surroundings, and had a very warm relationship with her daughter. She wanted to live, and had a critical attitude toward her pathological experiences. She was discharged to work.

Diagnosis: Schizophrenia (psycho-reactive onset).

We are presenting the data of the examination of the patient in the electrophysiological laboratory before and after treatment.

Electroencephalogram dated 20 October 1955 (before electric sleep treatment): The amplitude of the action currents was low, the hemispheres were working with inadequate synchrony, and there was a clearly expressed irregularity and individual slow waves (most pronounced in the parietal leads) in all the leads; in the occipital leads there was a poorly expressed α -rhythm; the reactivity of the cerebral cortex was markedly reduced.

Electroencephalogram dated 21 November 1955 (following the course of electric sleep treatment): The level of electrical activity of the brain had become somewhat greater, and there was irregularity only in the temporal leads; slow waves were predominant in the frontal and parietal leads; a periodic α -rhythm was recorded in the occipital leads; the reactivity of the cerebral cortex remained low.

Aside from the examinations of the electrical activity of the brain, records were made of oxyhemometric data in the patient. Before beginning treatment the curve of the blood oxygen saturation in the waking state was less than normal (94-92 percent). After an hour's observation, and sometimes even sooner, the patient went into a drowsy state, and the curve of the blood oxygen saturation gradually dropped to 82-80 percent.

In the electric sleep procedures, especially in the first half of the course of treatment, the initial background of the oxyhemograms was below normal, but during the electric sleep procedure the curve of the blood oxygen saturation slowly increased, reaching 96 percent and remained at this level, although the patient slept deeply.

After finishing the course of treatment with electric sleep, at which time a remission had occurred clinically, the blood oxygen saturation reached normal figures.

From the case history it follows that the patient had been subjected to psychic trauma (constant conflicts with her husband, and finally, the break with him) for a number of years, which, possibly, to some degree weakened the patient's nervous system; however, it did not lead to a nervous break -- the patient had been a Stakhanovite [a special degree of excellence in work] and a public-spirited worker at the factory, and had reared a daughter. New acute psychic trauma in August 1955 -- the death of her friend's mother -- led to a considerable weakening of her higher nervous activity: The patient lost sleep and lost her appetite, and she became weak physically, and was melancholic; finally, an infectious disease in the form of a severe sore throat led to her nervous break.

The fact deserves attention that reactive factors predominated initially in the psychopathologic picture of the disease against the background of a profound asthenia and general inhibition. The patient's hallucinations were of a psychogenic nature, and her statements were replete with the trauma which she had experienced and reflected it. Afterwards, she showed signs characterizing the establishment of a schizophrenic process. Delusional ideas of reference appeared and signs of psychic automatism; she was "in the power of an alien force", which made her think of "the terrible and the unknown".

After electric sleep treatment a remission occurred clinically; however, the patient's electroencephalograms even after treatment remained pathological. The catamnesis showed that after two months in the patient's condition deteriorated again.

It seems justifiable to say that the condition of the electrical activity of the brain may be a criterion for judging the prognosis of the disease.

Patient S., age 20, embroideress, was treated at the hospital of the Institute of Psychiatry from 29 August through 30 November 1955.

The patient's mother was sick with schizophrenia.

She had been born premature, and was a weak child. She was timid and touchy. In connection with her mother's illness she had been brought up first by an aunt, and then, in a children's home. She returned to her mother's family when she was an adolescent. She was a student in school for the ungraded. She completed seven grades and courses in embroidery. For the past three years she had worked as an embroideress in a linen shop. She began to menstruate at the age of 16, and her menstruation was regular. She was not married. She denied any serious somatic illnesses and head trauma in her history. The present illness had been preceded by severe, traumatizing experiences connected with a conflictual situation at home -- quarrels with her sister-in-law. The patient, who was usually quiet, and shy, became rude and irritable during the quarrels. After a change in the living arrangements in the family the situation became more favorable; nevertheless, the patient continued to be irritable, slept poorly, began to say that she couldn't cope with her work, and she would easily become inhibited and go off by herself. On 26 August 1955 she had an acute psychotic state: She didn't go to work, she said that everybody was laughing at her and she saw "wry, distorted faces". She stopped eating, and didn't sleep at all for several days; she chewed her nails, threads of yarn and scraps. She refused to go to a physician.

The patient was infantile. Her internal organs were not particularly abnormal. On neurological examination she showed no signs of organic involvement of the central nervous system. Clinical analyses of the blood and urine were not abnormal. The blood Wassermann test was negative.

At the time of admission the patient was markedly inhibited, stood in one position for a long time near her bed, and was almost inaccessible. She was fed by the personnel. She showed no interest in her surroundings. She occupied herself in chewing her nails or pulling her clothes about, or tousling her hair. She was mistrustful, on guard, showed a negative attitude toward therapeutic procedures. She had unsystematized delusions of persecution.

The patient was given 15 two-hour electric sleep procedures. She fell asleep during the procedures. The patient's condition began to improve comparatively quickly. The improvement began with a change in her disposition, which was noted particularly immediately after the electric sleep procedures. She became accessible, better-tempered, and went eagerly to the treatment procedure; she assisted the nurse in the operations for the routine procedure. She began to eat spontaneously, and she showed interest in reading. Gradually, her facial expression became animated, she lost her general inhibition, and the patient began to socialize with the young people in the department, but her delusional ideas of reference continued. They disappeared only after the course of treatment had been completed. She became quite collected, adequate, and wanted to be discharged and to return to work. Her night's sleep was restored, and she became physically stronger. She was discharged in a condition of complete remission.

Diagnosis: Schizophrenia, catatonic form.

Oxyhemometric curves were made in the patient in the waking state before treatment. The observations were made for several days at the same time of day, each lasting for two hours. The curves of blood oxygen saturation ranged within limits of 94-96 percent.

These investigations were continued during the course of treatment with electric sleep. Despite the fact that the patient slept during the electric sleep procedures, the curves of the blood oxygen saturation were stable and remained at a normal level (96 percent).

The patient was also examined in the electrophysiological laboratory before the beginning of the electric sleep treatment and after the end of the course of treatment before discharge. The characteristics of the electroencephalograms before treatment amounted to the following: Electrical activity of the brain was decreased, the cerebral hemispheres were functioning quite asynchronously, and slow waves of small amplitude and individual α -waves predominated in all the leads in the right parietal lead there were individual

sharp waves; in the occipital lead periodic α -rhythms with the frequency of 10 waves a second were recorded. The reactivity in all the leads was considerably reduced. At the end of the course of treatment with electric sleep the nature of the electroencephalogram was changed in the direction of a normalization of it: The level of electrical activity of the brain became much higher; α -rhythm predominated in all the leads with frequency of eight to nine waves a second mixed with individual slow waves.

As follows from the history, the patient was born premature, developed poorly, and had been unusual from childhood--shy, quiet, intellectually retarded--she could not progress in regular school. All this makes it possible to suppose that she had a heightened vulnerability and weakness of her nervous system. Prolonged psychic traumatization in the form of constant conflicts in the family still further weakened her fragile nervous system and brought her to a state of exhaustion. On this background the development of a schizophrenic process occurred, which in the patient was characterized chiefly by motor inhibition, stereotypes and inaccessibility. A reduction in the electrical activity of the brain was observed on the electroencephalograms during this period of the disease with an asynchrony in the function of the cerebral hemispheres, a predominance of slow waves with an almost complete absence of α -rhythm.

Since signs of protective inhibition predominated in the psychopathological picture of the disease, we considered the use of electric sleep expedient in the patient. Daily two-hour electric sleep procedures were the only method of treatment which led to a remission. Along with the clinical improvement we had the opportunity of noting also considerable changes in the electroencephalograms: An increase in the level of electrical activity; the α -rhythm became the dominant rhythm of the electrical brain waves in all the leads. Assuming that the α -rhythm is the optimum excitation rhythm of the cortical structure it may be considered that it reflects also the optimum conditions of rhythmical activity of the tissue which contributes to normalization of disturbed functions.

Therefore, in this patient the clinical remission coincides with the normalization of the electrical activity of the cerebral cortex and is confirmed by the electroencephalogram. It should be also noted that the factor which traumatized the patient was not adequately reflected in her pathological experiences either in the acute initial phase or subsequently.

Patient Ts., age 29, librarian, was in the hospital of the Institute of Psychiatry from 28 September through 17 October 1955.

There were mental patients among her distant relatives. She was the youngest in the family. In her childhood she had been lively, impressionable and whimsical. She made average grades in school. She completed 10 years of school and the technical library school. She denied any serious somatic illnesses and head trauma in her history. She began to menstruate at the age of 15 and was regular. She was not married. Her mental illness had developed in 1947, at which time the patient had expressed ideas of persecution, was excited, and a disconnected speech was noted at that time. After treatment in the psychiatric hospital the patient returned to work in her specialty, but she was not always able to cope with her work, and in connection with this she frequently changed her places of work. This deterioration of her mental condition had occurred following the death of her father. The patient began to meditate, went off by herself, and became irrelevant; she ate poorly, and during the past five years prior to the present hospitalization she had not slept well. She could not tackle her usual work.

There were no abnormalities in her internal organs. On neurological examination there were no signs of organic involvement of the central nervous system found. Clinical analyses of the blood and the urine showed no abnormalities. The blood Wassermann test was negative.

At the time of admission the patient was generally inhibited, had a mask-like expression on her face. She was confused and ambivalent: She wanted to be discharged, and at the same time she expressed her fears that she would not

be able to work. She had inconstant ideas of reference-- "everybody is saying that I am not the same as everybody else". She had no critical judgment with respect to her pathological condition, and confided in her physician that her neighbors "had persuaded" her to go to a general hospital for relaxation, and that there was no need for her to be put in this hospital Institute of Psychiatry; that she was the same as she always had been. In the department she remained aloof and wept. Her night's sleep was disturbed. She showed no emotional reaction to the death of her father. She answered all questions about his death in a calm, indifferent tone, without any affective coloration.

The patient was given electric sleep treatment without the addition of any drugs. She was given 12 two-hour procedures. Under the influence of the pulsating current she did not always fall asleep; nevertheless, after the procedure she noted that she was "calmed" and "in a better condition". Even during the course of treatment her general inhibition was lost, and the patient began to read, to take walks, and gradually to become active; she became acquainted with the other patients. Her delusions disappeared. She developed a critical attitude toward the pathological condition which she had had. From time to time she was somewhat disinhibited, laughed a great deal, talked a lot and loudly, but, as a whole, the patient's behavior was normal and adequate. While outwardly she was collected and active she remained emotionally indifferent and essentially autistic.

She was discharged to work.

Diagnosis: Schizophrenia (exacerbation psychogenically induced).

The patient was examined in the electrophysiological laboratory. Before treatment was begun with electric sleep the following data were obtained as the result of the examination. The level of electrical activity of the brain was moderate; there was asynchrony in the function of the cerebral hemispheres; high-frequency waves, particularly in the right frontal lead predominated in the right hemisphere, whereas in the left hemisphere the slower waves were pre-

dominant, particularly in the left frontal lead; there were α -waves every day, and an α -rhythm with a frequency of 10 waves per second was recorded in the parietal and occipital leads; in the left parietal lead the frequency of the α -waves was less (seven to eight in a second). The reactivity was reduced. Flickerings of light of increasing brightness somewhat increased the irregularity in the right parietal lead.

After completing the course of treatment with electric sleep the irregularity decreased somewhat, (but did not disappear), especially in the anterior portions of the cerebral hemispheres, and slow waves appeared also in the right hemisphere. The frequency of the α -rhythm in the right parietal lead decreased seven to eight waves a second. The cortical reactivity remained decreased.

An analysis of this observation shows that in a patient who had had a schizophrenic attack in 1947 a recurrence of the process had occurred under the influence of psychic trauma. The psychopathological picture of the first attack was characterized by excitation and delusions. The present exacerbation was characterized by general inhibition, confusion, depressive onlay and a sleep disorder. In contrast to the reactive depressions, where all the pathological experiences reflect the psychic trauma, this patient's experiences were without any emotional coloring, which constitutes an essential difference of the reactive states which develop on the background of a schizophrenic process from the psychogenic and depressive conditions of other etiologies.

As it had in a number of other patients, electric sleep led to a condition of complete remission: The night's sleep was regained, the motor inhibition was eliminated, the delusions disappeared and the patient's behavior became normal. However, features of the schizophrenic defect remained in the form of an emotional poverty. It is interesting that depressive components in the clinical picture were replaced by a somewhat heightened mood with disinhibition. This fact may be related to the characteristics of the process itself.

A comparative evaluation of the electroencephalograms before and after completion of therapy shows very insignificant beneficial changes: The reactivity of the cortex remained decreased, and the irregularity did not disappear. We may speak only of a tendency toward quiescence and normalization of rhythmical activity. Basically, the patient's electroencephalograms remained pathological to a considerable degree even after treatment, which, as must be supposed, is in agreement with the quality of the remission obtained.

Patient K., born 1896, housewife, was in the hospital of the Institute of Psychiatry from 6 October through 3 November 1955.

She came from a healthy family. She developed normally. She completed four grades of primary school. She had been given "in marriage" at the age of 15½. Her family life was unhappy. Her husband proved to be an alcoholic, left the family, and then returned. She had had one pregnancy. She had a grown-up daughter. Her entire life she had been a housewife, and only during the years of the War had she worked as courier and elevator operator. In 1917-1918 she had typhus and relapsing fevers; she denied any other serious somatic illnesses and head trauma in her history. She had her menopause at the age of 46-47. It went smoothly. Before her illness she had been energetic, and an active public-spirited worker.

She first became mentally ill in 1932, at which time she had a condition of acute psychomotor excitation, anxiety and inappropriate behavior: she was hospitalized in the Hospital imeni Kashchenko. After discharge for four years her condition was one of remission, and then, in 1936 and 1943 she was again in psychiatric hospitals in connection with a deterioration in her mental condition. The last aggravation developed acutely in the summer of 1955 in connection with psychic trauma. The patient had been relaxing in the country with her grandson, when her neighbor in the summer cottage suddenly died on her hands. She became very much excited, wept, and pitied the dead person. Her sleep was disturbed and she developed anxiety and delusional ideas of persecution and of being poisoned. She would awaken her

daughter at night, and ask her to "guard" her because her husband was trying to kill her. She hid knives and other sharp objects in her bed. She refused to eat, and considered her food poisoned. The patient was past middle age. She had lost weight. Her heart sounds were muffled. Her pulse was somewhat tense. The arterial pressure was 140/90 millimeters. On neurological examination no signs of organic involvement of the central nervous system were found. She noted a tremor of the lids and fingers of the outstretched hands. Clinical analyses of the blood and urine were within normal limits. The blood Wassermann test was negative.

At the time of admission and for the initial part of her stay in the hospital the patient was anxious, suspicious, fussy; her speech was rapid and loud and accompanied by gestures. Her statements contained individual unsystematized ideas of persecution and of reference. Her husband was "hiding a dagger" in order to "butcher" her. She upbraided him cynically. She told her physician that she was healthy and that "she had been sent to the hospital to relax" because she had "quarreled with her grandfather" (this is how she called her husband). She categorically denied any hallucinatory disorders and refused to tell about her pathological experiences: "Nothing happened; everybody is slandering me". The patient was irritable, and started arguments with the patients and personnel. She was tactless, interfered in conversations of the physician with other patients, and made inappropriate remarks. She could not sleep at night, and she walked about the department.

Electric sleep treatment was given. At first, the patient had a negative attitude toward the treatment. She said: "Put me to sleep and do something with me". Despite her delusional strain, she began to fall asleep in the first few electric sleep procedures; however, she categorically denied that she had been sleeping. Afterwards, when the patient's condition had improved, she told the physician that she had been afraid to admit that she slept at the procedures, because she thought that they would then "keep her from taking her night's sleep".

At the end of the course of treatment the patient's condition improved notably: Her night's sleep was regained, her fussiness disappeared, she became better-tempered, more collected, more adequate, participated in the work therapy in the hospital, and had fewer conflicts with those around her; her delusional strain lessened considerably, but she was not capable of any complete critical evaluation of her pathological experiences, she continued to call her husband "a miscreant enemy"; she had no warmth in her relations with her daughter.

The patient was given 10 two-hour electric sleep procedures and glucose infusions containing niacin. She was discharged in a satisfactory condition.

Diagnosis: Schizophrenia (defective condition).

The patient was examined in the electrophysiological laboratory both before the beginning of the electric sleep treatment and after it was concluded. On the electroencephalograms very considerable pathological changes were found which, with certain exceptions, remained after the treatment had been given.

Electroencephalogram dated 11 October 1955 (before beginning electric sleep treatment): The level of electrical activity of the brain was low, and the hemispheres were functioning with inadequate synchrony, there was a tachyrrhythmia everywhere, particularly pronounced in the frontal and parietal leads; there were slow waves of low amplitude, and the reactivity was markedly decreased on the electroencephalogram of both hemispheres, more on the left.

Electroencephalogram dated 31 October 1955 (after therapy had been concluded): The level of electrical activity of the brain remained low; there were slow waves in all the leads, but there was no irregularity and the reactivity was reduced.

In this observation the schizophrenic process had been of considerable duration (23 years), and had had a relapsing course. Undoubtedly, the patient's personality changed under the influence of the prolonged process, and features

of the schizophrenic defect appeared with considerable prominence.

The last exacerbation had been produced by acute psychic trauma and had developed in direct connection with this latter. The fact deserves attention that these experiences did not find any reflection at all in the psychopathological picture of the exacerbation observed. We observed a revival of the factors which had previously traumatized the patient; her husband's unfaithfulness, conflicts with him, and other family difficulties. Specifically, these experiences found their reflection in her delusional statements (my "husband is a miscreant, he will butcher me"). However, these experiences, essentially, were not the predominant ones either; most prominent was the patient's excitability, which found its expression in her fussiness, conflicts, tactlessness, which in combination with her emotional poverty and the absence of clinical judgment made it possible for us to speak of the existence of a schizophrenic defect. Under the influence of electric sleep treatment her delusional tension lessened considerably; the patient became quieter and more orderly in her behavior, more adequate, but the main features of the schizophrenic defect remained.

In comparing the clinical data with the data of the examinations of the electrical activity of the brain in this patient we believe it possible to note that the elimination of certain pathological signs, chiefly excitation and sleep disturbances is perhaps reflected in the disappearance of the high frequency waves from the electroencephalogram and in the appearance of slow waves. As far as the other psychopathological features inherent in the schizophrenic defect are concerned, the stability of the changes noted on the electroencephalograms corresponds to them: the low level of electrical activity, the markedly reduced reactivity, the absence of regional differences in the character of the electrical activity of different areas of the brain.

Patient R., age 33, sanitation physician was in the hospital of the Institute of Psychiatry from 11 October 1952 through 17 January 1953. She was admitted with complaints of melancholy, insomnia and headache.

Analysis of the blood at the time of admission showed the following: hemoglobin 58 percent; white blood count 4800, eosinophils two percent, stabs four percent, segmented neutrophils 69 percent, lymphocytes 20 percent, monocytes five percent; sedimentation rate 11 millimeters in an hour. The blood Wassermann test was negative. The urinalysis was within normal limits.

On neurological examination signs of vegetative insufficiency were noted--sweatiness and acrocyanosis.

At the time of admission the patient was melancholic, confused, and watchful. She did not consider herself mentally ill and referred everything to "overfatigue". However, it seemed to her that en route to the hospital one of the passengers had been a "secret attendant" and "the hospital orderlies were also looking at her differently from the way in which they looked at the others". She stated that she was being "specially checked". She remained by herself in the department, and avoided contact with those around. She had a tendency to interpret everything along the line of her delusional experiences. She was fixed on the factors which traumatized her. She wept a great deal. She didn't occupy herself with anything. She could not read: "My thought scattered and slipped away". The patient was exhaustible, fatigued quickly in conversation, drops of perspiration came out on her face, she blushed, began to cry, even if the conversation was about neutral subjects.

Electric sleep treatment was given according to the method of prolonged routines (the procedures were carried out during the first half of the day for four hours and for three hours in the evening). Under the influence of the pulsating current sleep inhibition did not always develop and was inadequately deep, having the nature of transitional states; most often, the patient was in a condition of drowsiness during the procedures, which only at times changed into sleep. During the course of treatment the patient's condition gradually improved: Her delusional statements stopped; afterwards, she developed a critical attitude toward the condition which she had had, she became more collected, calmer, but her exhaustibility remained, and she was incap-

able of prolonged strain at work. The fixation on the traumatizing factors which had played a part in the development of her last psychotic episode continued. No notable intellectual disturbances were found. She was discharged improved.

Diagnosis: Schizophrenia with reactive asthenic features.

As seen from the patient's history, the schizophrenic process began in 1943. At that time, her psychotic episode lasted for three months and began during a period of life which was difficult for the patient. After the period of the developed psychotic state, which lasted for two weeks, weakness, exhaustibility and difficulty in intellectual work were observed. The remission which occurred lasted for 8½ years, during which she successfully completed work at an institution of higher education. Deterioration in her condition began after a number of difficulties at the new place of work. The patient could not accomplish the entire volume of work, chiefly of an organizational nature. The signs of fatigability and sluggishness increased, headaches appeared, confusion, melancholy, ideas of reference, suicidal ideas and tendencies.

Therefore, her weakened nervous system reacted to the difficulties which had recurred with a psychotic outbreak. In the belief that reactions to high-powered stimuli had occurred here, we decided to apply protective therapy, for which electric sleep was used as a means of deepening protective inhibition. During the course of electric sleep treatment the main psychological signs (delirium, confusion and melancholy) lessened, but asthenic signs remained (exhaustibility, vulnerability and a certain fixation on the traumatizing factors).

Therefore, this observation, in which the schizophrenic process progressed with a considerable admixture of reactive components, attests to the favorable effect of electric sleep in the so-called "psychoreactive schizophrenic syndromes".

Patient L., age 36, did not work, and was in the hospital

of the Institute of Psychiatry from 26 December 1951 through 20 April 1952. She was admitted with complaints of melancholy and headaches.

She came from a healthy family. Her development in childhood was normal. She studied in a rural school, but was not graduated. She began to work early--at first in the kolkhoz, and later in a mine in the Donbass. She had been married; her husband died at the front. She had two children. She began to menstruate at the age of 14 and was regular. In 1936, during work in the mine she sustained a head contusion and fracture of the pelvic bones, and had a loss of consciousness. Afterwards, there were no sequelae of the trauma noted. By nature, she was lively, sociable, jolly, and well-disciplined.

In 1950, her psychotic state developed suddenly: anxieties, delusional ideas of persecution, and abnormal behavior. For several months she had been in the Svarov Psychiatric Hospital, from where she was transferred to her sister's house in Moscow and put into the hospital of the Institute of Psychiatry.

On objective examination she showed the following: She had a normal body build, and was well nourished. In the lungs there was vesicular breathing; on percussion there was a clear resonant sound. The heart borders were not enlarged, and the heart sounds were pure and somewhat increased. The pulse was rhythmical and of satisfactory quality. The blood pressure at the time of admission fluctuated within limits of 160/95-140/110 millimeters. The abdominal organs showed no pathology.

Fluoroscopy of the chest cage showed the following: The lung fields were clear, the costophrenic sinuses were clear, and the diaphragm was movable; heart: the left ventricle was questionably enlarged; the pulsations were ample; the aorta was normal. The blood analysis at the time of admission showed the following: Hemoglobin 67 percent, red blood count 4,480,000, white blood count 5600, eosinophils four percent, stabs three percent, segmented neutrophils 71 percent, lymphocytes 19 percent, monocytes three percent; the

sedimentation rate was 10 millimeters in an hour. The blood Wassermann test was negative. The urinalysis was normal. The optic fundus was normal.

On neurological examination no signs of organic involvement of the central nervous system were found. Before treatment she had been extremely inhibited, sluggish, and almost inaccessible. She answered questions in single syllables, and did not look at the person with whom she was talking. Her voice was hoarse, without modulation. Her face was mask-like. She did not give any information about herself. She did not relate her pathological experiences. She stated that she was healthy and asked to be discharged. When left alone she sat frozen in the same position. She did not socialize with the other patients, and she had to be fed by the personnel. No delusions or hallucinatory disorders were found in her behavior.

On 1 February 1952 electric sleep treatment was begun. On 3 February, she had her fourth electric sleep procedure; it lasted 2½ hours. The patient slept. At the conclusion of the procedure she awoke immediately. She was animated, smiled, and for the first time came to her physician spontaneously and said that she was getting lonely for her son and expressed the desire to see him; she also asked that she be given handiwork to do.

On 5 February she had her sixth electric sleep procedure which lasted three hours. The patient slept. She awoke several minutes before the procedure was over and asked that the "current be taken away". She assisted the laboratory worker in straightening up the ward after the procedure. Her facial expression was lively, confident, and her movements were free. She socialized actively with those around.

On 9 February following eight electric sleep procedures she was tense, melancholic, and hallucinated in the evening, and heard a radio broadcast to the effect that "the enemies had taken Moscow", she heard "the rumble of tanks passing nearby". Her blood pressure was increased to 160/100 millimeters, and after an hour, when the patient had quieted down somewhat, it dropped to 150/95 millimeters.

On 10 February the patient was melancholic, and worried about her son "no one came to see me"; she refused to go to treatment; she categorically denied what had happened the night before. Her arterial pressure was 150/90 millimeters.

On 12 February she had her tenth electric sleep procedure which lasted for three hours. The patient slept deeply, and her sleep continued for about 1½ hours after the current had been turned off. Again she noted that things were better for her: "I became stronger". Her blood pressure before the procedure was 150/95 millimeters; directly after the current had been turned off it was 135/95 millimeters.

On 20 February after 17 electric sleep procedures the patient became active and collected; she was completely adequate, had a lively expression on her face, her posture was relaxed, her speech was loud and confident; she showed considerable concern for her children: "I am healthy and strong; I can work, I have someone to take care of". She remembered her pathological condition hazily, "as though in a dream". Her attitude toward her previous condition was devoid of adequate judgment: "I do not know what happened".

On 27 February at night, she had motor and speech excitation, threw herself around the department, asked the patients to take her with them, expressed ideas of guilt, called herself "bad", "worthless", and promised to change. She categorically refused treatment, was negativistic, tense, and inappropriate. The electric sleep treatment was stopped.

Diagnosis: Schizophrenia, hypertensive disease, first stage.

In this patient the mental disease had begun acutely in 1950 and was characterized by delusional ideas of persecution, anxiety, and abnormal behavior. Afterwards, a condition developed which resembled catatonic stupor: General motor inhibition, inaccessibility, and absence of judgment.

The sudden onset in connection with some kind of psychogenic traumatizing factors or somatic illnesses and the structure of the psychosis itself (presence of delusions,

predominance of catatonic features later) make it possible to diagnose an acutely developing schizophrenic process.

The use of electric sleep led only to a temporary improvement, at which time the motor inhibition disappeared after four procedures; the patient became accessible, active and occupied herself in handiwork, assisted the personnel, showed adequate reactions and concern for her son. Afterwards, a new aggravation of her condition was observed with a somewhat different content of pathological experiences from those which she had previously. Hallucinatory disorders predominated: "They are broadcasting on the radio that Moscow had been taken by the enemies"; she heard the "rumble of passing tanks". The exacerbation was accompanied by an increase in blood pressure. The subsequent electric sleep procedures normalized the patient's condition for a certain time, and her blood pressure simultaneously decreased. However, after several days a new exacerbation of delirium occurred which was accompanied by motor and speech excitation, negativistic reactions (categorical refusal of treatment).

Our observations show that as a result of the application of the pulsating current in patients with schizophrenia with the catatonic symptom complex a transformation of the syndrome occurs: The general inhibition is eliminated and delusional and hallucinatory experiences are found similar to what occurs in the observation presented.

Patient G., age 26, housewife, was in the hospital of the Institute of Psychiatry from 2 November 1952 through 27 January 1953.

She came from a healthy family, developed normally, but during her school years she was "slender", and often sick. She completed seven years of school and a medical technical school, and worked as a nurse. At the age of 19 she was married and beginning with this time she occupied herself as a housewife. Her family life was happy. She had three pregnancies; the first ended in delivery; the last two were interrupted artificially. She had a daughter aged five years. Her menstrual cycle was regular. By nature, she

was lively, sociable, was interested in the theatre, occupied herself in a choir group ("she loved to sing"). During the past six years she had been seriously sick: She had had typhus fever, malaria, pneumonia, and in 1952 uterine adnexitis, at which time signs of thyrotoxicosis were noted for the first time.

Her present illness began in September 1952: She developed a headache, "my head split", her sleep was disturbed, she became reserved and irritable. Afterwards, she developed delusional ideas of reference: "everybody was following", "looking", "laughing" at her. She developed hallucinations, heard voices inside her head telling her that she should "get married". She felt that a "strange influence" was working on her. She was hospitalized.

Objectively: The patient was of normal body build and well nourished. Her skin had a yellowish tinge. She had a dry coated tongue. There was vesicular breathing in the lungs, and on percussion there was a resonant pulmonary sound.

Her heart borders were not enlarged; her heart sounds were clear and there were no murmurs. The pulse was of good quality, rhythmical and not tense. Her blood pressure was 135/90 millimeters. Her abdominal organs showed no abnormalities.

Fluoroscopy of the chest cage showed the following: Her lung fields were clear, the leaves of the diaphragm were equal and movable; her costophrenic sinuses were clear; heart--straightening of the "waist"; the pulsations were weakened; the aorta was normal. Blood analysis at the time of admission showed the following: Hemoglobin 66 percent; white blood count 4800, basophils one percent, eosinophils four percent, stabs three percent, segmented neutrophils 60 percent, lymphocytes 2 percent, monocytes eight percent, sedimentation rate five millimeters in an hour. The blood Wassermann test was negative. Urine analysis was normal. Her nervous system showed no signs of organic involvement.

Before treatment the patient was confused, didn't know

where she was, and was not properly oriented as to time; she didn't understand what was happening to her. She asked: "What is happening to me; is this a special disease, am I mental?". She looked suspiciously at her physician. She gave information about herself reluctantly. She hallucinated continuously; voices were speaking inside her head, and they had been brought there from outside--"there is a dispute in my head". Something was reminding her of all the errors which she had made in her lifetime. She answered the voices loudly, at times justifying herself and objecting: "I didn't do that"; at other times, she admitted that she was guilty, wept, and asked forgiveness.

She had unsystematized ideas of persecution: "They were stimulating her uterus by chemical means; her whole body and head were burning with fire". They had changed her, she had never been like this. "They were suggesting alien, strange thoughts" to her. She was unable to explain the figurative meaning of proverbs; she interpreted her physicians questioning in a delusional way: "Why are you asking me; so that you can judge me later?". She was tense, refused to eat, asked that "she be killed immediately" and not be tortured. She told how she was "being blown up with gas" which was coming from "somewhere under the earth". She remained aloof, for the greater part of the day she lay in bed, covered herself up with a blanket and laughed loudly, "I don't want to, but the voices are ordering me to". Her night's sleep was disturbed in connection with her hallucinatory experiences --"The voices are torturing me the whole night".

Electric sleep treatment was given (prolonged, routines twice a day) in combination with insulin (up to 16 units), whereby hypoglycemic phenomena were produced (sweatiness, facial hyperemia without stupefaction). The course of treatment lasted 25 days.

In the initial electric sleep procedures no sleep inhibition occurred, but the patient became peaceful, stopped answering the voices, and after the current was turned off she slept for two to three hours.

At the evening procedures she went into a mild drowsy.

state, which gradually passed into a deep sleep, which not uncommonly lasted until morning. Afterwards, the patient fell asleep both in the morning and evening procedures, but the sleep did not attain sufficient depth. The patient changed her position, and from time to time she muttered something, and only after the current was turned off did sleep inhibition deepen noticeably. On the average, during the 24 hours the patient slept 15-17 hours.

She gradually came out of her psychotic state. First, the unpleasant sensations in her body stopped. Almost at the same time the patient stopped expressing delusional ideas of influence, but she continued to hear the voices inside her head. However, the nature of her hallucinatory experiences changed: The voices said "neutral words", and did not demand anything of her. The patient became more collected, better-tempered, talked enthusiastically with her physician, told about herself, about her child, and worried about it, wanted to go home; her suspiciousness disappeared. She regained her night's sleep. She recovered well physically. Her blood pressure at the time of discharge was 125/70 millimeters.

Of the psychopathological symptoms the pseudohallucinations remained: In the evening, the patient continued to hear "an indistinct voice inside her head". According to the statement of the patient, the voice did not disturb her. She had no complete critical judgment of her disease, particularly with respect to pathological experiences relating to the initial period.

Discharged in a condition of considerable improvement.

Diagnosis: Schizophrenia, hallucinatory-paranoid type.

The patient was examined in the laboratory of higher nervous activity according to the method of speech reinforcement.

Before treatment a weakening of the associative function of the cerebral cortex was observed: A conditioned association was formed only in the forty-first combination. After-

wards, in connection with an increase in the psychopathological symptoms the investigation of the neurodynamics was interrupted. The patient refused to go to the laboratory, interpreted the investigations in a delusional way--"a special examination and trial".

The investigations were renewed only during the second half of the course of treatment. A simple dynamic stereotype was formed and consolidated. It was noted that after the electric sleep procedure the patient coped more easily with problems posed her by the investigation. Thus, the replacement of conditioned stimuli in the stereotype by their verbal designations had been impossible before the electric sleep procedure; on the same day, following the procedure, the patient was able to solve this problem.

The revision of the stereotype was also accomplished without difficulty.

As seen from the history, the patient had suffered a number of serious diseases in the course of the past six years: Typhus fever, malaria, pneumonia, and in 1952, uterine adnexitis.

It may be supposed that all this weakened her nervous system, which could not withstand the development of mental disease. The pathological process developed acutely during the course of two months. The leading symptoms in the psychopathological picture of the disease were pseudo-hallucinations, hallucinations of general sensation, delusional ideas of influence and persecution, signs of depersonalization, which did not give rise to any doubts diagnostically and gave us the right to speak of a schizophrenic process.

The investigations conducted in the laboratory of higher nervous activity during the acute period of the disease spoke for a disturbance in the associative function of the cerebral cortex and a state of disconnection of the signal systems. The conditioned association was formed only in the forty-first combination. The elaboration of differentiation proceeded in a retarded fashion.

During the course of treatment it was possible to note a normalization of the principal nervous processes along with a clinical improvement--a simple dynamic stereotype was elaborated readily. In our opinion, the fact that the patient easily and adequately solved the problem posed her by the experimenter whereas before the procedure this problem had been too difficult for her, is of essential significance.

As seen from the observation presented, the use of electric sleep (as a modification of sleep therapy) in combination with therapeutic doses of insulin gave a beneficial therapeutic effect, despite the great severity of the pathologic process. Therefore, our attempt at combined application of electric sleep with small doses of insulin proved to be justifiable and justified.

Patient Yu., age 40, turret lathe operator, had been in the hospital of the Institute of Psychiatry from 26 March through 30 May 1952.

She was admitted with complaints of headache, insomnia and loss of appetite. Among her relatives there were mentally ill patients. She developed normally. Before the age of 20 she lived in the country and worked in a peasant homestead. In recent years, she had been working in Moscow. She married at the age of 28. Her family life was unhappy: Her husband was alcoholic and died in 1949. She had always been the "bread-winner of the family". She had two children. She denied any serious somatic diseases in her history. She began to menstruate at the age of 14 and was regular.

By nature she was reserved and selectively sociable. She was hard working and strict with herself. She became ill after the death of her husband in 1950: she developed headaches, her sleep was disturbed, she heard her name being called; she noted that they "didn't like her", were looking at her, were laughing at her. She was put into a mental hospital; after insulin treatment she came out of her psychotic state and worked for two years.

A new deterioration began in January 1952: She began to

have fears, expected "violence" from her neighbors, sat by the door at night with an axe in her hands, and she commented that men "were drawn to her as to a magnet"; at her work "they made a fool" of her. She stopped eating because of the fear that "poison had been put" into her food.

On objective examination: The patient was pale, and she showed signs of loss of weight. There was a normal resonance in her lungs; the breathing was vesicular. The heart borders were not enlarged. The heart sounds were pure. The pulse was rhythmical and of good quality and not tense. The blood pressure was 130/80 millimeters. The abdominal organs were not abnormal clinically.

Fluoroscopy of the chest cage showed the following: In the middle field of the right lung there was a Ghon tubercle; there were no other changes found in the lungs. The heart and aorta were normal.

Analysis of the blood: Hemoglobin 69 percent; red blood count 4,100,000, white blood count 5200, stabs two percent, segmented neutrophils 72 percent, eosinophils four percent, lymphocytes 19 percent, monocytes three percent; sedimentation rate eight millimeters in an hour. The Wassermann test was negative. The urine showed no abnormalities.

On neurological examination there were no signs of organic involvement of the central nervous system found.

She was completely oriented. She answered questions enthusiastically and was somewhat loquacious. Her glance was sharp and intense. She considered herself sick. She was convinced that the neighbors in her apartment house were connected with some kind of organization which was "pursuing the aim" of using her "as a woman". Her fellow workers were also involved "in this company". She was sluggish, passive, and indifferent to her children. She refused to take food, slept poorly, and heard voices calling her: "Actress!"

Electric sleep treatment was given (20 prolonged procedures) in combination with hypoglycemic doses of insulin (up to 12 units). During the initial procedures only a

drowsy state was noted; beginning with the second half of the course of treatment she developed deep sleep after the procedures which not uncommonly lasted even after the current had been turned off.

The patient was satisfied with the treatment given and said that electric sleep was "calming her nerves", and expressed the desire "to go through with the whole treatment", so that she could "completely recover". At the end of the course of treatment she became more lively, more adequate, showed interest in her work, was concerned about her children, became stronger physically, and recovered her night's sleep. However, she did not fully regain her critical judgment with reference to the pathological condition which she had had.

She was discharged to work in a condition of considerable improvement.

Diagnosis: Schizophrenia, hallucinatory-paranoid type.

For many years the patient had been in a severe conflictual situation, had worked a great deal, and had actually supported her whole family alone. She suffered because of the death of her husband. It may be supposed that all of the long-acting traumatizing factors listed led to a weakening of the functions of the higher centers of her nervous system and contributed to the development of her mental disease.

The analysis of her pathological experiences gives us the grounds for speaking of a schizophrenic process. The patient's delusional constructs were inappropriate, did not reflect the content of the factors traumatizing her, had a tendency toward generalization and were of a systemic nature: Both neighbors and fellow workers were all "involved in an organization", which had the aim of destroying her. Her auditory hallucinations were not topical either. All this gives us the grounds for speaking of the hallucinatory-paranoid type of schizophrenic process.

Electric sleep treatment in combination with insulin

proved to be effective and led to a remission.

In concluding the chapter on the treatment of schizophrenia with electric sleep we should say that the therapeutic effect depends on the duration of the disease, the severity of the process and the type of schizophrenia. In cases where we could not obtain improvement in the course of the disease by means of electric sleep we combined this gentle treatment with hypoglycemic doses of insulin, after which the elimination was observed of such severe processes as delusional ideas and hallucinatory experiences. This made it possible to avoid using shocking doses of insulin the effect of which is far from being indifferent to the central nervous system, particularly on the cerebral vessels.

We observed the most satisfactory therapeutic effect in the hallucinatory-paranoid type, but only when psychic traumatization played a part in the pathogenesis of the disease. Electric sleep treatment removed not only the neurotic onlays but also the basic symptom processes.

An analysis of the observations which we have presented makes it possible to speak of various forms of reaction by the patients in whom an exacerbation of the schizophrenic process occurs under the influence of psychic traumatization or in whom the psychic trauma precedes the establishment of the schizophrenic process. When the schizophrenic process develops in direct association with psychic trauma the experiences traumatizing the patients are reflected in the psychopathological picture of the disease, particularly at the beginning of it, and only afterwards do the schizophrenic symptoms become prominent.

The content of the traumatizing factor is not always and very little reflected in the pathodynamic structure of a relapse which develops after a psychogenic situation in the patients who have had schizophrenia for a short time. In patients who have had schizophrenia for a long time the traumatizing situation which develops after psychic trauma is not always reflected in the psychopathological picture of the deterioration, but thereby a revival occurs chiefly of the previous pathological symptoms.

Our observations have shown that the first clinical changes in the course of treatment of patients with electric sleep occur in the affective sphere: The tension and anxieties are alleviated; afterwards, the intensity of the hallucinatory disorders decrease. On a background of this quiescence the delusional experiences were gradually smoother over and a critical attitude toward the disease appeared. The best therapeutic effect in schizophrenia, where a course of electric sleep treatment was given, was obtained in those patients in whose psychopathological picture catatonic symptoms predominated with features of depression or asthenic-depressive components.

An analysis of oxyhemograms has shown that the degree of blood oxygen saturation in the majority of schizophrenic patients before treatment is somewhat lower than normal, which is in complete agreement with the generally accepted concepts concerning anoxia in schizophrenic patients. The curves of the oxyhemoglobin dynamics recorded in the same patients during electric sleep procedures showed that during the period when the pulsating current was acting the oxyhemoglobin concentration was increased compared with the original level. In those patients in whom the original background of the oxyhemogram was within normal limits, the oxyhemoglobin concentration did not decrease during the electric sleep procedures but rather stayed at the same level which, in our opinion, constitutes an essential difference in the condition of sleep which occurs under the influence of the pulsating current not only from drug-induced sleep but also from physiologic sleep.

The fact attracted attention that the increase in the oxyhemoglobin concentration in the electric sleep procedures coincided with a condition of an improved feeling of well being of the patients after the conclusion of the procedure.

We are presenting an observation by V. I. Rusakov of the Moskvoretzskiy Neuropsychiatric Dispensary (head of the dispensary is T. I. Ivanova) attesting to the effectiveness also of outpatient treatment with electric sleep.

Patient Ts., age 25, a moving picture operator was under

the observation of the Moskvoretskiy Neuropsychiatric Dispensary since May 1956.

She came in with complaints of increased irritability, melancholy, anxieties, decrease in the ability to work, and insomnia. She came from a healthy family and developed normally. She completed seven grades and moving picture operator courses. She had worked as a moving picture operator for several years.

In early childhood she had had measles, jaundice and croup. At the age of 10 she suffered severely with diphtheria which produced a number of complications: myocarditis, nephritis and neuritis. At the age of 18 in connection with a long-lasting low-grade fever and a general poor feeling of well being she was hospitalized in a hospital for somatic diseases where a diagnosis of thyrotoxicosis was made. She began to menstruate at the age of 13 and was regular. She married at the age of 24. She had no pregnancies.

In childhood she had been cheerful, lively, loved her friends, was an organizer in her group, was able to think up interesting games and activities. She attempted to "be fearless", and taught herself "to suppress fear". With this aim in view she would walk in the cemetery at night and sleep in the open air. She wanted to be physically strong, and she toughened herself physically. She carried water buckets until she was exhausted after setting herself the problem of carrying a certain number of buckets. She took on any physical work with joy. In her youth she was a day dreamer, impressionable, loved everything beautiful and read a great deal. She loved Shakespeare, Gertsen, Chernyshevskiy. She married for love, but soon became convinced that her husband was a short-witted man who did not contribute to her spiritual needs. She considered herself unfortunate in life: "I love music, literature, the theatre, and my husband is not interested in any of these". She considered herself capable ("I might have become a well educated woman"), but her health condition did not permit her to complete "even evening school".

The present illness developed gradually. It was preceded

by a whole series of long-lasting traumatizing factors. Beginning with 1949 the patient had been living under unfavorable conditions. Since 1955 her situation had become worse because of conflicts with her husband's relatives, who were against this marriage. Beginning with 1950 she developed headache, and her sleep was disturbed. In the evening, the patient could not fall asleep for a long time, had nightmares, and she was not refreshed when she awoke in the morning but rather depressed and tired. Afterwards, she gradually became irritable, tearful, and she began to have a feeling of "a lump in the throat", particularly after she had been excited. Beginning with 1955 she had hysterical attacks (sometimes "her feet became paralyzed"). In the spring of 1956 her condition became considerably worse: Her attacks became more frequent, she lost appetite, her "food became tasteless", she was "tortured with insomnia"; the patient lost considerable weight, and her ability to work decreased. She developed fears--she was afraid of the darkness and of being alone. She came into the dispensary with all these complaints.

On objective examination there were pronounced signs of loss of weight. Tachycardia--pulse 96 beats a minute and labile. Blood pressure 110/75 millimeters.

On neurological examination an increase in the pharyngeal and conjunctival reflexes was noted. The knee reflexes were obtainable from an extended area. There was acrocyanosis and a diffuse stable red dermographis.

The patient was melancholic, anxious, and had an expression of suffering on her face. In telling about her pathological experiences she wept and became excited. Her voice trembled, red spots appeared on her face, and she broke out into perspiration. She sought the aid and sympathy of the physician. She told about her pathological experiences in detail and with great readiness. She spoke of her complete inability to gain control of herself; everything irritated her; she could not tolerate noise, loud or shrill sounds; could not listen to the radio--it fatigued her; she could not read, because even on insignificant strain her headaches increased. She was "tortured by fears", and it seemed to

her that a man was standing behind her curtain or that someone was hidden under the bed. At night, she heard indistinct rustlings, some kind of muffled steps, and it seemed to her that a ladder was being placed against her window; and that someone was climbing up it. She heard a key turning in the lock, and she heard the door open slightly. She jumped up, awakened her husband and tied the door knob to the bed with a towel. In the morning, in the presence of her husband she herself laughed at her fears, but as soon as she was left alone, even in the daytime, she again began to be afraid, and she felt some kind of "invisible presence". She had no delusions and had a critical attitude toward her pathological symptoms and evaluated the situation correctly. She expressed a great desire to be cured. Her affect was unstable and vulnerable.

Diagnosis: Neurotic reactions in a hysterical personality.

The patient was given electric sleep treatment on an outpatient basis (25 two-hour procedures). During the first eight procedures she fell asleep only after the current had been turned off, and afterwards, she began to sleep during the procedures; not uncommonly, the sleep continued even after the current had been turned off.

The first signs of improvement were noted after 15-16 electric sleep procedures. She returned home calmer after the treatment, alert; her fears disappeared, she fell asleep peacefully without hypnotics and sometimes awakened at night with a hazy feeling of alarm but she quickly fell asleep again. In the first half of the day (before the electric sleep procedure) her condition at first was unstable--her head hurt, she "felt irritable". At the end of the course of treatment her headaches disappeared, and her night's sleep was completely restored to normal; the patient became stronger physically. Her disposition was alert and even. She became calm and collected. Her "previous ability to work" came back. Only certain symptoms of vegetative insufficiency remained even after the completion of the course of treatment.

The number of such illustrations could be increased; how-

ever, even what has been presented shows that sometimes a favorable effect may be obtained from electric sleep treatment under conditions of a neuropsychiatric dispensary without hospitalizing the patients. To be sure, special quarters and a proper organization of medical observation during the performance of electric sleep procedures are required for this.

4. Presenile Psychoses

Among our first 10 observations on the study of the effectiveness of electric sleep in different forms of mental diseases nine belonged to the group of presenile psychoses and one, to the group of psychogenic depression during the period of menopause.

During the electric sleep procedures a drowsy condition was observed in some of these patients, from time to time passing into sleep; however, after the procedures they did not experience any feeling of calm or alertness. In all these patients except one, in whom no reaction was noted to the effect of the current, a negative therapeutic result was obtained; the patients felt notably worse after the electric sleep procedures; they experienced an even greater "internal irritation, tension, weight"; their melancholy became worse, their anxiety and fears increased, and their delirium became generalized. In connection with this, we were forced to stop any further investigations in this direction. As an illustration we are presenting one of our observations.

Patient D., age 50, housewife, was in the hospital of the Institute of psychiatry from 12 November 1949 through 22 April 1950.

She came from a healthy family. She developed normally. She completed gymnasium /secondary school/ and one course in the faculty of historical physiology. For some time she was a teacher, and then she went into library work. At the age of 22 she was married. Her family life was happy. She had an adult son. She had had typhoid fever, malaria, and re-

peated sore throats. She began to menstruate at the age of 12, and stopped in 1949. By nature she was overanxious about her health, sensitive.

At the age of 28 she went to the psychiatrist for the first time because of her insomnia, melancholy and fear of "sudden death". These signs developed after the death of her father. She was treated by the psychiatrist for several years, and gradually came out of her pathological condition. In the autumn of 1948, all these signs of her previous nervousness recurred: she left work and was afraid to leave the house. She had ideas that she was sick with cancer, and she was depressed by the thought of "an imminent inevitable death", she did not sleep, refused to eat--"I don't care if I die".

On objective examination the following was found: The patient was past middle age, was pale, and showed pronounced signs of loss of weight. There was vesicular breathing in her lungs. The percussion sound over her lungs had an amphoric suggestion. The heart was enlarged to the left. Her heart sounds were muffled. There were no murmurs. The pulse was of satisfactory quality and was not tense and was labile. The blood pressure was 130/80 millimeters. There were no abnormalities in her abdominal organs.

Fluoroscopy of the chest cage: The lung fields were emphysematous, the lung roots were thickened; the costophrenic sinuses were clear, the diaphragm was movable. The heart and aorta were within normal limits for her age. The pulsation was labile.

Analysis of the blood: Hemoglobin 57 percent; white blood count 4900, sticks three percent, segmented neutrophils 65 percent, eosinophils five percent, lymphocytes 19 percent, monocytes eight percent; sedimentation rate 12 millimeters in an hour. The Wassermann test was negative. The analysis of the urine was normal.

On neurological examination there were no signs of organic involvement of the central nervous system found.

The patient was tense, melancholic, and had an expression of suffering on her face. She was constantly giving attention to herself, and was completely fixed on her own sensations. Every day she found new signs of "a terrible disease". She spoke of "approaching inevitable death". During the ward rounds she followed her physician, and she asked the other patients the same question, namely, whether they found any signs of cancer on her. She ate poorly. Her night's sleep was fitful and interrupted.

Electric sleep treatment was begun. During the procedures it was not possible to produce sleep inhibition. The feeling of calming which was usually noted by the patients was not found here. The patient frequently changed her position, and spoke loudly, asked that the current be turned off, because "the irritation in her chest was being increased". After turning off the current the patient declared every time that things were worse for her. Her feeling of alarm increased, as did also her feeling of inner tension; there was a "stone lying on her heart". The patient wept, groaned, fell on her knees, asked everyone for help, asked that she be saved from her approaching death. She said goodbye to everybody, stating that "catastrophe would be coming promptly"--she and those close to her would die. In connection with the increase in her anxiety, melancholy and the generalization of her delusion electric sleep treatment was stopped in the eighth procedure.

Through the example of this patient an increase in the psychotic symptoms may be seen in direct connection with the electric sleep therapy given, which made us refrain from the use of the pulsating current in the treatment of presenile psychoses.

We should like to emphasize particularly that our attempts to use electric sleep in the involutional psychoses, for example, in involutional depression were not crowned with success, but even, in a number of patients, produced an exacerbation of the condition. Apparently, in the presence of syndromes of anxiety and fear accompanying the involutional processes, the use of the pulsating current does not contribute to the development of protective inhibition, but,

conversely, causes an exacerbation of the pathological symptoms connected with the emotional disturbances. It is interesting that observations made at the Institute of Therapy at the Academy of Medical Sciences USSR by G. V. Sergeyev show that in patients with hypertensive disease with signs of the menopause in the form of hot flushes, lability in the emotional sphere, disturbances in sleep and a condition of general restlessness no good effect was obtained through electric sleep treatment of them either. This makes us believe that the signs of involution with disturbances in the emotional sphere constitute a contraindication to the use of electric sleep.

It is also known that in patients with hypertensive disease, especially in the early stages, the use of electric sleep treatment is contraindicated. This is due to the fact that in these patients there is a disturbance of the autonomic nervous system, which leads to a disturbance of the sleep-wake cycle. In such cases, electric sleep treatment can lead to a further exacerbation of the pathological process. Therefore, in patients with hypertensive disease, electric sleep treatment should be used with great caution and only after a thorough examination by a specialist.

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CHAPTER II

Electric Sleep Treatment of Certain Neuropsychiatric Diseases of Children and Adolescents

In the pediatric department of the Institute of Psychiatry of the Ministry of Health USSR (head of the hospital -- T. P. Simson) electric sleep treatment has been given to children with neuropsychiatric diseases since 1950. The observations were carried out by the senior scientific worker, A. N. Korganova.

Children were selected for electric sleep treatment who were in the stage of disease in which the clinical picture gave us the right to think of the existence of elements of protective inhibition. The electric routines used were distinguished by milder characteristics compared with those in adults: the current strength did not exceed eight to ten microamperes with an impulse lasting 0.3 milliseconds and at a frequency which was regulated between one and ten impulses a second. The duration of the procedure was 30-40 minutes; the maximum was an hour. The procedures were given daily; in all, there were 15-20 procedures for the course. The sensations experienced by the children in the area of the eyes -- the site of application of the electrodes -- at the beginning of the procedure were evaluated differently: "tickling," "tapping," "sticking," although there were no complaints of any unpleasant sensations.

Sleep occurred quickly, as early as five to ten minutes after starting the procedure, continuing even after the current had been turned off. The time of falling asleep and the sleep itself outwardly was entirely similar to physiologic sleep. The duration of the sleep was, on the average, from two to three hours. Treatment was given to 90 children from 7 to 16 years of age. There were 81 girls and 9 boys. According to age, the children were distributed in the following way: there were two patients from seven to eight years of age; 33, from 10 to 12; 55 patients from 13 to 16. There were 62 with a diagnosis of rheumatic encephalitis; six with a diagnosis of rheumatic psychosis in the acute state; six with influenzal encephalitis; five with encephalitis with a syndrome of sensory disturbances; five with symptomatic psychosis (subacute stage); and six children with a reactive state. Therefore, the majority were children suffering from the cerebral type of rheumatic fever.

Along with the clinical observation an examination of the dynamics of higher nervous activity was carried out in 38 children according to the motor method with speech reinforcement devised by A. G. Ivanov-Smolenskiy. In 40 cases the metabolism was also investigated (biochemical laboratory, senior scientific worker E. Ya. Skuin¹). Thereby a study was made both of the individual ingredients of the blood -- the total protein, the albumin-globulin ratio, the amino acid nitrogen and ammonia, cholesterol, and the detoxifying function of the liver (sodium benzoate test).

Of the 68 children suffering from the cerebral type of rheumatic fever, only seven had been admitted with the initial manifestations of the rheumatic disease (choreic type of encephalitis); 51 children had suffered from various types of rheumatic fever (cardiac-articular, articular and chronic) for one-two-three years, and finally, in 10 there had been no acute attacks of rheumatic fever prior to admission to the hospital, and only frequent sore throats, pains and swelling in the joints had been noted.

Electric sleep treatment proved to be most effective in children suffering from rheumatic encephalitis, particularly its choreic form. Of 36 children who had chorea, practical recovery was observed in 21, and 13 had improvement. Electric sleep treatment was unsuccessful in only two children suffering from the severe relapsing form of chorea. Very quickly, even beginning with the sixth to seventh procedures, a considerable reduction of the hyperkinesias was observed, which was manifested in particularly striking fashion in children with severe hyperkinesias of the muscles of the face, trunk and extremities with a marked disturbance in gait and almost complete inability to move about and take care of themselves. By the eighth to ninth procedure the children were already attempting to take food independently and to walk, and at the end of treatment their disturbed functions had been completely recovered. Irritability, tearfulness and the depressed mood also disappeared. The night's sleep and daytime naps became deep and calm. Fatigability decreased. A considerable reduction in hypotonia could be noted, and Gordon's sign and the inequality of the reflexes disappeared.

The children themselves noted an improvement in their conditions after six to seven procedures, and therefore accepted them with great enthusiasm. After treatment the children made a good physical recovery, and gained up to two or three kilograms in weight; a number of vegetative

disturbances disappeared (unpleasant sensations over the heart -- palpitation, cutting in the cardiac area, pronounced tendency toward perspiration). The liver changes observed in a number of children (enlargement and tenderness) disappeared. Where there were metabolic disturbances, most often a high cholesterol concentration in the blood (up to 200-240 milligrams percent) and a change in the albumin-globulin ratio, a normalization of metabolism could be noted.

The experimental investigations of the neurodynamics indicated a disturbance in the cortical processes: weakness of the stimulatory process (intersignal reactions and double grips), and in individual children an inadequacy of concentration of active inhibition (successive inhibition, difficulty in forming differentiations, disinhibition of differentiations). During the course of electric sleep treatment the strength of the grip increased, the latent period decreased, and intersignal reactions and stepwise conditioned motor reactions disappeared, which may constitute evidence of an increase in the concentration of the stimulatory process. As an illustration we are presenting an excerpt from a case history.

Patient Ts., age 15, was admitted 30 November 1952 with complaints of twitchings of the hands and feet and a change in speech.

Her period of gestation and birth had been without pathology. At the age of one year the girl had a mild case of measles and whooping cough. At the age of four she had pneumonia; at the age of five she had dysentery. She became sick with the choreic type of rheumatic encephalitis in 1950 for the first time. In January 1952 her tonsils were removed; in July 1952 she had her second attack of severe chorea. Over the course of a month she was in the hospital, and was discharged before she was completely healthy; the hyperkinesias remained. In October 1952 she had a sore throat, after which she again had hyperkinesias of the extremities, irritability and tearfulness.

A pallor of the skin was noted and there was considerable moisture of the palms and hypotonia of the muscles of the extremities. Her lungs were normal. The heart borders were not enlarged; there was a systolic murmur at the apex of the heart, and the second sound was accentuated over the pulmonary artery. The blood pressure was 112/62 millimeters; the pulse was 62 beats a minute, rhythmical, and of satisfactory quality. The liver was palpated at the costal margin and

was painless. The white blood count in the blood was somewhat increased -- 9,000. The blood cholesterol was 136 milligrams percent; the albumin-globulin ratio was decreased (0.8). The antitoxic function of the liver was normal -- in the sodium benzoate test the hippuric acid excretion was 93 percent of normal.

In the neuropsychiatric condition exhaustibility, lability of the mood, touchiness, and sleep disturbance attracted attention. The disorder of coordination of the movements of the extremities and the hyperkinesias of the muscles of the extremities were very pronounced; speech was made difficult because of the spastic contractions of the facial muscles.

On neurodynamic examination of the higher nervous activity the following was found: the conditioned motor reaction was formed beginning with the eighth combination and was consolidated, but there were frequent double grips (stepwise) and the latent period was prolonged up to two seconds, which indicates a weakness of the stimulatory process. Differentiation was worked out beginning with the second combination. The conditioned motor reaction to new stimuli was formed with the positive stimulus beginning with the second combination, and differentiation was elaborated during the course of the procedure. The revision of the stereotype proceeded without difficulties, but the transfer of the direct stimulus to the verbal stimulus was not successful, which was evidence of a disturbance in the interrelationship of the first and second signal systems. Therefore, on the basis of the investigation a weakness could be noted of the stimulatory process and a disturbance in the interrelationship of the first and second signal systems.

After the electric sleep treatment (20 procedures) the girl felt good; she became lively, active, gained three kilograms in weight. The color of her skin was normal; a slight systolic murmur was heard at the apex of the heart; the liver decreased in size, her speech became possible without difficulty, the hyperkinesias disappeared, and a slight muscular hypotonia remained.

On examination of the neurodynamics an absence of the stepwise type of grip could be noted and a decrease in the latent period to 0.5-0.3 second, which attests to an increase in the concentration of the stimulatory process.

This observation indicates the great effectiveness of electric sleep, which evidently is associated not only with

a decrease and a deepening of the protective inhibition already existing in the patient but also with the effect of the current directly on the brain, primarily, possibly, on the hypothalamic area. Because of this, a recovery of the regulation of the cortical-subcortical interrelationships occurs quickly (rapid disappearance of hyperkinesias, normalization of the neurodynamics).

In the next group of 26 children, who had rheumatic encephalitis without the choreic syndrome, practical recovery was observed in 12 and improvement in 13 children after electric sleep treatment. The following was observed in the clinical picture of the disease: headache, dizziness, sensory disturbances, diplopia, sluggishness, depression, exhaustibility, sleep disturbance in the form of sleepiness or insomnia (in the latter case the play of feelings, anxiety, and fears were more pronounced). There were nystagmoid twitches on extreme abduction of the eyes, hyperactive tendon reflexes, and persistent red dermographia in the neurological condition.

At the end of the treatment almost the entire psychopathological picture disappeared in the children, who were treated with good result. They became active, lively, participated in classroom sessions, recovered well physically, gained in weight (up to three to four kilograms), and certain vegetative disorders disappeared (palpitation, cutting in the cardiac area, and a tendency toward perspiration). The metabolic disturbances (high cholesterol concentration in the blood, change in the albumin-globulin ratio, disturbance in the antitoxic function of the liver) which had been observed in a number of children became normal.

The experimental investigations of the neurodynamics before treatment showed a weakness of the associative function (difficulty in formation of the conditioned motor reaction), and in individual children there was an inadequate mobility of the nerve processes (difficulty in revision of the stereotype). Finally, in a number of patients there were disturbances of the interrelationships between the first and second signal systems. After electric sleep treatment these disturbances also became normal.

In those children in whom an improvement was observed as a result of electric sleep treatment only very slight headache and slight exhaustibility and sluggishness remained.

Only in one child was there no therapeutic effect noted.

As an illustration we are presenting an excerpt from a case history. Patient B., age 13 years and eight months, was admitted to the hospital 23 May 1952 with complaints of a poor appetite, irritability and tearfulness.

Pregnancy of the mother and delivery of the child had been without pathology. At the age of three the girl had had a severe case of measles complicated by pneumonia (she was unconscious) as well as dysentery; at the age of 11 she had whooping cough. After the first rheumatic attack she was put into the rayon hospital at the beginning of 1952. After her discharge from the hospital the girl developed sluggishness, tearfulness, and became retarded. She did not go to school. At the end of March her condition became worse in connection with a sore throat she had suffered.

In the patient's physical condition weight loss, pallor of the skin and moisture of the palms attracted attention. The lungs were normal. The heart borders were within normal limits. At the apex of the heart there was a slight systolic murmur. On fluoroscopy of the chest cage the following were found: the heart was of mitral type; the pulmonary conus was slightly prominent, and the apex of the heart was rounded. As far as the blood was concerned, there was a slowing of the sedimentation rate to three millimeters in an hour and eosinophilia (13 percent). The cholesterol in the blood was increased to 165 milligrams percent; the albumin-globulin ratio was normal (2,08). The antitoxic function of the liver was reduced.

In her neuropsychiatric condition the patient had a headache, most often in the morning, which was accompanied by a feeling of nausea, dizziness, and, from time to time, a change in the color of the surroundings. At times, she had diplopia, and sometimes light or dark lines flitted before her eyes. Her sleep was disturbed. In the evening she did not fall asleep for a long time, and in the morning she woke up with difficulty.

On neurological examination nystagmoid movements were noted on extreme abduction of the eyes; the tendon reflexes were lively and obtainable from an expanded area; the Achilles tendon reflexes were unequal. Investigations of the neurodynamics revealed the following: the conditioned motor reaction was formed only in the 44th combination, after the 11th combination with passive gripping, and was not stable afterwards, being imperfect in the 56th, 64th, 81st

and 82nd combinations; the strength of the grip was weak. These data indicate a weakness of the stimulatory process and an inadequacy of the associative function. Differentiation was established beginning with the second combination and was immediately consolidated. The positive conditioned motor reaction to the new stimulus was formed beginning with the fourth combination; and differentiation was formed during the course of the procedure. Therefore, on the basis of the data presented above we may speak of a weakness of the stimulatory process and an inadequacy of the associative function.

Electric sleep treatment was given (20 procedures). The girl slept for two and one-half to three hours. After treatment her general feeling of well being was completely satisfactory; her disposition was even, her sleep was restored to normal, and her headache and dizziness stopped; diplopia and the perception of color changes in the surroundings disappeared; the knee reflexes were equal on both sides. A normalization of the cortical processes was noted in the neurodynamics.

In the group of children sick with other forms of encephalitis (influenzal type with syndrome of sensory disturbances) encouraging results were also obtained. Under the influence of electric sleep treatment the headache gradually decreased and then completely stopped; the night fears disappeared, and her disturbed night's sleep was restored to normal; fatigability was decreased considerably. Sensory disturbances (disturbances in spatial relationships, etc.) and diplopia disappeared. The children were discharged feeling good and had gained up to two kilograms in weight.

In the case of residual signs after encephalitis or in the case of chronic slowly progressive forms the therapeutic effect was much less, although there was no doubt of the improvement in the patients' condition.

After electric sleep treatment an improvement could also be noted in the psychopathological picture of the disease in 11 children with acute psychotic episodes (rheumatic and symptomatic psychoses). Usually, treatment was begun after the elimination of the toxicosis and the state of severe excitation. Under the influence of electric sleep treatment the fears were gradually eliminated, particularly the fear of death, restlessness, anxiety, hallucinations; and severe depressive states.

Experimental investigations of the neurodynamics indicated a considerable disturbance in the cortical processes. Weakness of the associative function was expressed not only in difficulties but often even in the impossibility of forming a conditioned motor reaction, and a frequent general inhibition of it was observed. The inadequacy of concentration of active inhibition was manifested both in the considerable difficulty in forming differentiations and in the frequent disinhibition of them. [Loss of inhibition of them; hence, elimination of the differentiation.] The interrelationship of the first and second signal systems was disturbed and, finally, phasic states were noted -- paradoxical and ultra-paradoxical phases. The existence of them speaks for the deep-seated qualitative change in the work of the cerebral hemispheres, whereby the cortical cells, according to N. I. Krasnogorskiy, cannot tolerate severe stimulation and react to the strong stimuli either weakly or not at all, developing protective inhibition.

After electric sleep treatment weakness of the associative function and phasic states were eliminated; the concentration of active inhibition was increased. However, final elimination of the psychotic state in the children was achieved through the simultaneous use of antibiotics.

We are presenting an excerpt from a case history as an example.

Patient Shch., age 15, was admitted to the hospital 15 October 1952 in an acute psychotic state.

According to her mother, the girl had complained of headache and confusion for two weeks. Beginning with 31 October her condition changed markedly, and her sleep was disturbed. She refused to eat, began to talk to herself, would not allow herself to be dressed or undressed.

Psychopathological predisposition was denied.

Delivery of the child had been pathological (transverse position of the fetus). The child was delivered at term, and cried immediately. Her early development was normal. She grew up quiet and affectionate. She went to school for seven years and completed seven grades. She always occupied herself diligently and conscientiously; read a great deal and did work for the community. She had the following diseases: at the age of 10 months she had scarlet fever in a mild form; at the age of three years she had measles, and

at the age of 11 she had whooping cough of moderate severity. She frequently suffered from sore throats; recently, she had had complaints of pains in the joints. The present illness began in the summer of 1952. She developed a sore throat, after which she had swelling and pain in the joints of the extremities. After a certain time she developed headaches and dizziness, and when she was in the horizontal position she had a sensation of pulsation throughout her body. Houses appeared small; the patient heard voices. Her condition gradually deteriorated, and in August the girl took an examination for technical school but could not survive the competition. She was very much traumatized by this situation, cried a great deal, and had ideas of committing suicide. In October she was admitted to trade school, where she stayed only several days, because she again developed intense headaches and dizziness; and in the horizontal position black and white spots appeared before her eyes and among them there were red streaks which took on the outlines of people -- distorted faces, hands and noses. The patient became suspicious; it seemed to her that everyone around disliked her, and she noted sleepiness.

Physical condition: respiratory organs were normal; the heart borders were normal and there was a slight muffling of the heart sounds; the pulse was rhythmical, of satisfactory quality, 82 beats a minute.

Blood pressure was 110/55 millimeters. At times, she complained of a feeling of sticking in her cardiac region. Her joints were normal, but there was a considerable crunching in her knee joints. With respect to the blood, the sedimentation rate was slow (four millimeters in an hour). The cholesterol level was decreased (to 96 milligrams percent) and the albumin-globulin ratio was also decreased. The antitoxic function of the liver was normal.

In her neuropsychiatric condition the following were found: insufficiency of convergence, positive Romberg sign, pronounced vegetative disturbances (salivation, increased tendency toward perspiration, cyanotic color of the face and extremities); the girl was depressed, tearful and disinhibited. She told about herself eagerly, but confused dates and events. She was anxious, slept poorly, and had auditory hallucinations; she had pulsations throughout her body and expressed delusions of reference; she refused to eat and noted sensory disturbances. She was emotional, sought the aid of the physician, and wanted to be cured.

The following was found through examination of the neuro-dynamics during the period of her psychotic state: the strength of the stimulatory process was weak; constant disturbances occurred in the positive conditioned motor reactions and in the differentiations elaborated, which was evidence of cortical inhibition (equalizing, paradoxical and ultraparadoxical phases). In the case of light stimuli the selective transfer to the second signal system was complete; for sound stimuli, it was inadequate, which may be explained by the pathological condition of the auditory analyzer -- "I hear horns in my head all the time."

After treatment with antibiotics and drug-induced sleep with a transition to a conditioned reflex state [of sleep] the patient remained practically the same. She continued to be fearful, melancholic and said that people didn't like her, that they didn't want to treat her thinking that she was bad. She complained of a headache and pulsations throughout her body.

Beginning with 10 November electric sleep treatment was begun. During the procedure the girl fell asleep rapidly and slept up to two hours. By the 10th procedure a considerable improvement could be observed: the headaches decreased, the patient became quieter, her night's sleep became normal, her appetite was regained, and the ideas of reference disappeared. At the end of the treatment (20 procedures) the psychotic signs, headaches, dizziness, sticking in the cardiac region disappeared; the girl became more alert; her neurological signs disappeared also. The cortical processes became normal, but weakness of the stimulatory process remained.

Taking into consideration the fact that ideas of reference existed in the patient and that she heard voices (sometimes assuming an imperative nature), that a refusal to eat was observed and that there was a pronounced state of general inhibition it was possible to consider the occurrence of an acute schizophrenic outbreak here with elements of a catatonic state. However, her accessibility, the lively emotional state of the girl, the presence of neurological signs, and the disturbance of the sensory synthesis spoke against this supposition. The presence of sore throats in the history and indications of swelling and pain in the joints, as well as muffling of the cardiac sounds and pains in the cardiac area, crunching in the joints, disturbances of the cholesterol and protein metabolism made it possible

to establish the existence of a rheumatic disease of the central nervous system (rheumatic encephalitis).

The favorable effect of electric sleep in removing all the psychopathological symptoms, particularly hallucinations, was particularly striking in the clinical picture of the disease. The fact also deserves attention that penicillin treatment and treatment with drug-induced sleep which were used before the electric sleep gave practically no results.

Finally, in the last, very small group of children (six) with reactive states, electric sleep treatment was also successful: headaches, sluggishness, disturbances in mood, depression, fears disappeared; the night's sleep was regained; the children became lively and active and participated in class sessions.

We attempted to use electric sleep therapy in children suffering from traumatic involvement of the central nervous system; however, they promptly refused it, because they complained of an increase in the headache, did not fall asleep, went to the treatment procedure reluctantly.

As we have already mentioned above, the greatest percentage of children and adolescents treated with electric sleep suffered from the cerebral form of rheumatic fever (70 percent). This is partly explained by the fact that the favorable therapeutic result obtained at the very beginning of the use of electric sleep in the choreic form of rheumatic encephalitis attracted our attention, and, for that reason, the number of admissions of patients with the cerebral form of rheumatic fever to the hospital increased. We were not wrong in our assumptions and obtained a beneficial therapeutic effect in almost 95 percent of the patients. A favorable effect of the pulsating current was also observed in still other diseases. Below, we are presenting a summarized Table from which it is seen that a beneficial therapeutic effect was noted in 96 percent of the patients.

On the basis of what has been presented we came to the conclusion that electric sleep treatment of children and adolescents with certain neuropsychiatric diseases is very effective. The effect of the pulsating current is expressed not only in an increase and deepening of the protective inhibition but also in a direct influence of it on the brain, as a result of which the regulation of cortical-subcortical interconnections is very rapidly restored to normal.

Effectiveness of Electric Sleep Treatment of Children

Diagnosis	Total	Number of patients			
		Prac- tical reco- very	Consid- erable improve- ment	No ef- fect	Wors- ening
Rheumatic encephalitis (choreic form)	36	21	13	2	-
Rheumatic encephalitis (residual forms)	26	12	13	1	-
Rheumatic psychosis	6	1	5	-	-
Virus and influenzal encephalitis	11	3	8	-	-
Symptomatic psychosis	5	-	5	-	-
Reactive state	6	6	-	-	-
Total	90	43	44	3	-

Our observations constitute clinical proof of this: rapid disappearance of hyperkinesias, disappearance of expression, recovery from a disturbance not only in the daytime but also in the night's sleep, although the electric sleep procedures were carried out only in the daytime.

In patient Sh. with rheumatic psychosis we observed a disappearance of the psychopathological picture only after the use of electric sleep; nevertheless, neither penicillin therapy nor pharmacologic sleep with a transition to conditioned reflex sleep produced any effect.

Finally, in the case of brain trauma not only was there no effect obtained but there was even an aggravation noted from the electric sleep: the headaches increased, the feeling of well being worsened, and the children refused the treatment. Transfer of this group of children to pharmacologic sleep treatment and then to conditioned reflex sleep gave a good result.

CHAPTER III

The Application of Electric Sleep to the Clinic of Internal Medicine (The Treatment of Patients with Hypertensive Disease)

The favorable results obtained in the treatment of patients with electric sleep who suffer from asthenic states of somatogenic origin led to the idea of using electric sleep also in certain diseases of the internal organs.

Theoretical considerations made us look first of all into the matter of those diseases in the genesis of which disturbances in the cortico-visceral relationships play a significant part, and specifically, hypertensive disease.

The observations which we made at the Institute of Psychiatry of the Ministry of Health USSR on the treatment of patients with hypertensive disease with mental disorders showed that during the course of treatment with electric sleep the feeling of well being in the patients improves, headache disappears, sleep is regained, and the objective indices are in agreement with this -- the blood pressure dropped.

Beginning with 1951, investigations were made in the cardiologic hospital of the Institute of Nutrition of the Academy of Medical Sciences USSR (director -- O. N. Molchanova) on the therapeutic application of electric sleep in hypertension, and then in gastric ulcer (O. F. Limcher, Ye. A. Beyul, O. L. Gordon and V. A. Oleneva) the results of which were briefly presented in a review of the literature.

Beginning with 1953, G. V. Sergeyev at the Institute of Therapy of the Academy of Medical Sciences USSR (director -- A. L. Myasnikov, Active Member of the Academy of Medical Sciences USSR) has been carrying out electric sleep treatment on patients with hypertensive diseases with a comprehensive clinical-physiological examination of them.

The results of these observations constitute the contents of the present chapter.

According to current concepts, hypertensive disease is a neurosis of the higher central nervous system centers underlying which there are disturbances in the interrelationships of the excitatory and inhibitory processes, as the result of

which foci of static excitation arise in the cerebral cortex. As a result of this, various vegetative-humoral disturbances develop, particularly an increase in blood pressure. Arterio-sclerotic damage to various organs and systems is superimposed on the complex of its neurogenic symptoms only in the late stages of hypertensive disease.

These concepts of the pathogenesis and clinic of hypertensive disease underlie its pathogenic therapy, in connection with which therapeutic-prophylactic measures are directed at the recovery of the disturbed course of the principal nerve processes.

I. P. Pavlov's tremendous service was his indication of the favorable effect of protective inhibition as a physiological measure of protection for preventing the death of the nerve cell, with which it is threatened in various pathological conditions. Naturally, the conclusion was drawn as to the necessity of increasing the phenomena of protective inhibition where they are inadequate during the course of various diseases.

Clinical practice has completely confirmed the propriety of this principle which has been advanced by physiologists.

At the Institute of Therapy of the Academy of Medical Sciences USSR and under the direction of Corresponding Member of the Academy of Medical Sciences USSR N. I. Speranskiy treatment was given to patients with hypertensive disease using pharmacologic sleep in various forms.

Clinical observations have shown that in all the variants where pharmacologic sleep has been used for a long time more or less pronounced signs of intoxication may be observed. What has been presented gives a basis to the considerable interest which is being directed to the electric sleep problem at the present time.

At the Institute of Therapy of the Academy of Medical Sciences USSR electric sleep is being used in the treatment of patients with hypertensive disease stages I, II and III.

Electric sleep treatment is begun after the patients have been in the hospital for seven or eight days, at which time the blood pressure drops to the limits possible, and the patients become accustomed to the hospital surroundings.

The observations deal with 143 patients with hypertensive disease, of which there were 10 with stage IA, 28 with stage IB, 65 with stage IIA, 27 with stage IIB, and 13 patients with stage IIIA. There were 75 men and 68 women. According to their ages the patients were distributed in the following way: there were 27 persons from 21 to 30 years of age; 28, from 31 to 40 years; 59, from 41 to 50; and 29 patients from 51 to 60 years of age. In all, 2,389 electric sleep procedures were used.

The principal indices in the evaluation of the effectiveness of electric sleep treatment were the following: decrease in blood pressure, normalization of sleep and improvement in the general condition -- the recovery of the ability to work.

As the result of a course of electric sleep treatment (on the average from 15 to 25 two-hour procedures) a decrease in blood pressure with a normalization of sleep, improvement in the general feeling of well being, and a recovery of the ability to work were achieved in 90 patients (in 6 with stage IB; in 32 with stage IIA; in 47 with stage IIB; and in 5 with stage IIIA).

The recovery of the function of sleep, decrease in headache, and improvement of the general condition without a decrease in blood pressure were observed in 32 patients (in 23 with stage IIA; in 9 with stage IIB).

Thirteen patients showed an insignificant improvement in the sense of deepening of sleep and an improvement in their general condition with no decrease in their blood pressures (in three with stage IIA; in ten with stage IIB).

In eight cases (two with stage IA; one with stage IB; one with stage IIA; one with stage IIB; three with stage IIIA) no improvement occurred from electric sleep treatment, despite the adequate number of procedures used. A marked emotional instability and excitability were characteristic of all these patients.

During the course of the observation of the reactions in the patients with hypertensive disease during their electric sleep treatment certain rules and regulations were noted as a response to the use of a single procedure. All the patients fell asleep very readily and quietly. They awoke quietly also. As a rule, the patients, on awakening, noted a sensation of "freshness in the head" and general alertness.

However, the good feeling of well being during the process of administration of the first five to seven electric sleep procedures was rapidly replaced by the usual state of general depression and a feeling of heaviness in the head.

At the end of the course of treatment, following 15-17 electric sleep procedures, the good condition following each procedure remained much longer, and, finally, became more firmly established.

The depth of sleep during the electric sleep procedure and that after the pulsating current was turned off were different. The majority of patients awoke as soon as the current was turned off; however, some of them continued to sleep even after the current had been turned off. It was noted that within certain limits an increase in the strength of the current and an increase in the frequency of the impulses accelerate the process of falling asleep.

In the majority of the patients with hypertensive disease regular decrease in the blood pressure was noted at the end of each electric sleep procedure by 10-15 mm. of systolic and 5-10 mm. of diastolic pressure. While the decrease in blood pressure following each procedure was replaced by a return to the initial level one to one and a half hours afterwards, following 10-15 procedures and particularly at the end of the course of treatment the decrease in the level of blood pressure following each procedure was permanent.

As the result of a course of electric sleep treatment the systolic pressure usually decreased by 20-30 mm., and the diastolic, by 10-20 mm.

In patients with stage IIIA hypertensive disease the blood pressure, as a rule, practically did not decrease either after a single observation or after the regular course of treatment.

We observed a number of rules and regulations with respect to sleep itself in the treatment of patients with hypertensive disease with a course of electric sleep. At the beginning of the course of treatment, following five to seven procedures, the night's sleep was increased, and the nature of sleep itself changed. The bad dreams disappeared, and whereas previously the patients had spoken of the day which had passed with all its cares and troubles in their sleep, now the dreams were of a more interesting and not so

troublesome nature. In the morning, the patients felt much more alert, and the feeling of weight in the head lessened.

Afterwards, following 10-12 electric sleep procedures, the patient also slept after dinner, which provided him with rest in the middle of the day. During the first electric sleep procedures the patients developed only a drowsy condition. As the result of a course of treatment the total number of hours of sleep per day reached 8 to 12. The patient became able to fall asleep quickly in the evening, sleep soundly without dreams and, on awakening in the morning, to feel alert and cheerful.

Along with the hypotensive and sleep-normalizing effect observed in certain patients electric sleep had a favorable effect also on the retrosternal pains, decreasing them. The extrasystoles noted in certain patients were decreased in number.

On days when the weather changed considerably, and particularly when there was a marked change in barometric pressure during the same day, with raw foggy weather and a strong wind, the electric sleep procedures proved to be less effective. The patients fell asleep more slowly, did not sleep so well, complained of headache and a general poor feeling.

What has been stated here also confirms the observation made by M. Ye. Shnitser and Ye. A. Gavrilova at Kislovodsk in the balneological treatment of patients with hypertensive disease.

In all the patients the sleep which occurred under the influence of the pulsating current was no different in its clinical characteristics from ordinary normal physiological sleep. In women who had hypertensive disease and who were treated by electric sleep the menstrual cycle and menopausal phenomena accompanied by various emotional onlays sometimes reduced the success of treatment, complicated the means of carrying out the procedures which had been elaborated, and required greater individualization of the latter and a longer course of treatment.

These observations are in agreement with the data of Z. A. Kirillova who has treated women with involutional psychoses.

Individual patients with hypertensive disease in stages IIA,

IIB and IIIA, who suffered from constant sleep disorders and in whom various hypnotic pharmacologic agents had been used in various combinations without giving the anticipated effect, were demonstrative of the effectiveness of application of electric sleep. The patients suffered from insomnia, and only after a course of electric sleep treatment did their sleep disorders disappear.

As an illustration we are presenting clinical observations.

Patient G., age 49, chemical engineer, was treated at the Institute of Therapy of the Academy of Medical Sciences USSR from 17 through 30 November 1954.

At the time of admission she complained of a stubborn headache, dizziness, pains in the cardiac area, palpitation, shortness of breath, general weakness, persistent sleep disorder in the form of insomnia, bad dreams and a general depression in the morning, and increased excitability.

She had developed normally. She successfully completed 10 years of school and was graduated from a chemical institute. At the age of 24 she was married, had five pregnancies of which four terminated in delivery (the children are alive), and one was interrupted artificially. She began to menstruate at the age of 16, and has continued regularly up to the present time. She denied serious somatic illnesses. She had always been cheerful, jolly, loved sociability, had never been reserved, but, at the same time, was restrained and well balanced. She selected her specialty according to her own wishes, she loved the work, and she obtained satisfaction in doing it. In her everyday life she was quite energetic and active. She established relationships with people simply, without strain. She was characterized by her organizational ability and her skill in arranging her time properly. Her reactions to life situations were adequate and brief.

The present illness developed in 1947, at which time she had a severe headache, increased fatigability and excitability.

All the pathological signs described increased. In 1948, a diagnosis of hypertensive disease was made in the patient. In 1952, she was in the First City Hospital for this disease, from where she was discharged with a certain improvement. The therapeutic effect was temporary. Beginning with the summer of 1954 her condition deteriorated again, and in

connection with that the patient was admitted to the Institute of Therapy of the Academy of Medical Sciences USSR.

On clinical and laboratory examination the following were noted: the second heart sound was accentuated over the aorta; her blood pressure at the time of admission was within limits of 220/100-190/100. There were no other notable signs of pathology in the internal organs. There was a sinus tachycardia on the electrocardiogram.

Fluoroscopy of the chest cage: the heart was of the aortic type with a moderately enlarged left ventricle, sluggish and low-amplitude pulsation, and the aorta was elongated and thickened.

Clinical analyses of blood and urine were within normal limits. The blood cholesterol was 270 milligrams percent.

On neurological examination no signs of organic involvement of the central nervous system were found. Before treatment the patient had become asthenic, there were marked variations in mood, and she was fixed on her pathological sensations.

Beginning with 24 November electric sleep treatment was begun. A drowsy state was noted for the first time during the fourth procedure, and a decrease in blood pressure was noted after the current was turned off (before the procedure 180/100 millimeters; after it, 130/80 millimeters). During the course of electric sleep treatment a normalization of sleep and a decrease in blood pressure gradually occurred, and simultaneously her general condition improved also (the patient was given 24 electric sleep procedures). At the end of the course of treatment the blood pressure had become stable: systolic -- 150-140 millimeters; diastolic -- 80-90 millimeters. Her sleep was regained, and the patient slept from nine to ten hours a day. All her neurotic reactions lessened; the patient became calm, collected, her mood was alert and stable. She was discharged to work practically healthy.

Diagnosis: hypertensive disease, stage IIB.

On Fig. 29 a diagram is presented which characterizes the dynamics of the decrease in blood pressure during the course of electric sleep treatment; the continuous curve shows the number of hours of sleep during the 24 hours of

the day; the cross-hatched columns show the height of the blood pressure before electric sleep; the shaded columns, after electric sleep (top -- systolic; bottom -- diastolic pressure). As seen from Fig. 29, the number of hours of sleep during the day gradually increased in a somewhat wave-form fashion; the blood pressure decreased both during each individual procedure (if we compare its level before and after sleep) and after the course of electric sleep treatment.

An analysis of this case shows that in a personality which had always been characterized by sufficiently strong and well-balanced nervous processes (before the disease she had been energetic, active and was able to cope readily with the difficulties of life), a weakening of the principal nervous processes and of their mobility occurred under the influence of a number of chronic traumatizing factors (war years, serious disease of her husband and his death) as a result of which the hypertensive disease developed.

The effects of the pulsating current contributed to a recovery and normalization of the neurodynamics, which was expressed clinically in a recovery of the function of sleep, in a hypotensive effect, and in a considerable improvement in her general feeling of well being.

Patient T., age 48, a sorter, was at the Institute of Therapy of the Academy of Medical Sciences USSR from 15 November through 21 December 1954. At the time of admission she complained of headache accompanied by nausea, dizziness, cutting pains in the cardiac region, shortness of breath on walking and vigorous movement, superficial unrefreshing brief sleep accompanied by bad dreams.

These symptoms began to trouble the patient in 1946-1947 following difficult personal experiences, when it became clear that her husband was not returning from the war.

At this time she began to have a disturbance in her menstrual cycle. Her last menstruation had been 1 May 1948. She did not go to the physician. Her increased blood pressure (190/100 millimeter) was noted for the first time in October 1953 at the time of a dispensary examination of the workers in her institution. She had never been treated, and she was admitted to the hospital only on the advice of the physician observing her. In the past two years variations in her blood pressure had been noted (190/110-100/100 millimeters [?]).

She had been born into a family of a working man in which there were nine children. Her parents were poor. She spent her childhood in Moscow. She completed four grades of the city school. She was married at the age of 16 and lived with her husband for 20 years. She had four pregnancies: two deliveries and two abortions. Her children were grown up and healthy.

In 1941, her husband died at the front. During the period of the Second World War the patient was in Moscow and experienced considerable food deprivations.

At the age of eight she had measles; at the age of ten, pneumonia. In 1947, pulmonary tuberculosis was found (hemoptysis). Tubercle bacilli were never found in the sputum.

Prior to 1954 she had been under the observation of a tuberculosis dispensary. After that, she was taken off the records, because the process in the lungs had stopped.

Since childhood she had been quiet and well balanced. She had always been sociable and liked groups. She made friends with other people quickly, simply, and without strain. Her reactions to external stimuli and to waiting were adequate. She liked her work, and she was interested in it. She was purposeful, collected, was able to distribute her working and resting time properly. She met life situations quite calmly.

Before her illness her sleep had been sound, prolonged and refreshing. A change in environment did not disturb her sleep.

Her skin and visible mucosae were somewhat pale. Her joints were of normal configuration, mobile and painless.

Heart: borders were within normal limits; the sounds were muffled; the second heart sound was accentuated over the aorta. The blood pressure at the time of admission was within limits of 190/120-170/100 millimeters.

Lungs: the borders of the lungs were within physiological limits, and the mobility of the pulmonary margins was not restricted; breathing was vesicular everywhere.

The abdomen was soft and painless. The liver and spleen

could not be felt. Urination was free. The kidneys could not be felt. There was no costovertebral angle tenderness. The urine was normal.

Blood analysis: hemoglobin 68 percent; red blood count 4,520,000; color index 0.75; white blood count 7600; stabs 4 percent; segmented neutrophils 56 percent; eosinophils one percent; lymphocytes 30 percent; monocytes nine percent; sedimentation rate 10 millimeters in an hour. Blood cholesterol was 200 milligrams percent.

Fluoróscopy of the chest: the heart was transverse, the left ventricle was notably hypertrophied; the aorta was thicker than normal, and the diaphragm was mobile.

The optic fundus showed no pathological changes.

Diagnosis: hypertensive disease, menopausal neurosis.

She was given 22 electric sleep procedures, which exerted a considerable hypotensive effect: the blood pressure before the beginning of treatment had been 180/110; after it, 140/90 millimeters. Her sleep became normal: before treatment her night's sleep had been superficial, no more than five and one-half hours without refreshing the patient and was accompanied by alarming nightmares; after treatment, it increased to nine hours. In addition, the patient slept one and one-half to two hours during the electric sleep procedure itself and no less than one hour after dinner. Therefore, the amount of sleep she obtained in a 24-hour period was 12 hours. The nature of her sleep changed also: it became deeper, refreshing; her dreams completely disappeared.

The patient's general condition improved considerably; she became alert, and her working capacity was restored.

In Fig. 30 we are presenting the dynamics of the blood pressure during the course of electric sleep treatment. As seen from Fig. 30, the number of hours of sleep gradually increased, and her blood pressure decreased (see key for Fig. 29).

Therefore, the observation presented is similar to the previous one both with respect to the causes of the development of the hypertensive disease, its clinical course and the therapeutic effect.

In observing the dynamics of the clinical course of

hypertensive disease during the course of treatment of the patients with electric sleep the author made an attempt as much as possible to clarify the importance of suggestive and conditioned-reflex factors in the mechanism of the physiological effect of electric sleep.

A group of 35 patients with hypertensive disease of stages I, II and III was separated out in which one of the main complaints was a disorder of sleep expressed to varying degrees up to complete insomnia.

The essence of the control observations amounted to the following: after a seven- or eight-day preliminary clinical examination, when the patients had become adequately adjusted to the new surroundings, electric sleep treatment was begun, but during the first six or eight days they were given the so-called "base-line procedures," that is, without switching on the current. The electrodes were applied to the patients, and it was explained that the current characteristics were such that it would produce no sensations at the time it passed.

The two-hour procedures without switching on the current were carried out every day and always at the same time (from 11 a.m. to 1 p.m.). Before and after the procedure the blood pressure was measured. Two hundred and forty-five two-hour procedures were performed on these patients without switching on the current.

The observations showed that in 8 of these 35 patients a drowsy condition was sometimes noted during the "base-line procedures"; however, their feeling of well being remained without any apparent change regardless of the duration of the procedure (from 30 minutes to two hours). The blood pressure remained at its high initial levels; the night's sleep remained interrupted, superficial and not uncommonly was accompanied by unpleasant dreams. Following the procedures without the use of current the majority of the patients complained of weakness, fatigue and a feeling of heaviness in the head. All the other symptoms of the disease remained the same.

Afterwards, the pulsating current was switched on, and during the first few procedures sleepiness developed in some of the patients of this group which at the end of the procedure changed into sleep. In the majority of these patients a decrease in the blood pressure was noted directly after

turning off the current, as usually occurred after the therapeutic electric sleep procedures. Even those patients who did not fall asleep under the influence of the pulsating current noted an improvement in the feeling of well being directly after the procedure; their blood pressure also dropped below the original. The changes mentioned in the general condition of the patients were to a considerable degree associated with the length of time they were under the influence of the pulsating current and reached its greatest degree of expression at the end of the two-hour procedure.

Afterwards, during the course of electric sleep treatment the blood pressure in the patients with hypertensive disease stages I and II dropped to normal. In the patients with hypertensive disease of the III stage no such reduction in blood pressure was noted, although their general condition improved considerably, and sleep was restored to normal.

In the majority of the patients of this group the 24-hour sleep at the time of discharge reached 10-11 hours. The sleep which occurred during the procedures did not interfere with their falling asleep during the hours after dinner. The night's sleep became deeper and more refreshing. The patients were discharged and were essentially capable of working.

It was characteristic that on their "days off" the patients who had been given 10-12 electric sleep procedures became sleepy during the same hours (from 11 a.m. to 1 p.m.) at which they had been given the electric sleep procedures on their work days. In patients who were given the "base-line procedures," that is, without the current, no sleepiness occurred during these hours. Therefore, the suggestive factor which was the predominant one and essentially the only one during the administration of "base-line procedures" did not exert any beneficial effect on the course of hypertensive disease even in those patients in whom a superficial state of sleep inhibition developed under the influence of suggestion at such procedures.

G. V. Sergeyev believes that the conditioned-reflex factor still plays a certain part with respect to the rapidity of falling asleep under the effect of the pulsating current, but only after a number of procedures with the current has been administered, at which time a conditioned reflex for time has been elaborated.

As an illustration of what has been stated we are presenting clinical observations.

Patient P., age 34, housewife, had been in the hospital of the Institute of Therapy of the Academy of Medical Sciences USSR from 12 September through 18 October 1955 with the following diagnosis: hypertensive disease, stage IIA.

She had been admitted with complaints of a stubborn headache, chiefly in the occipital region, palpitation, pains in the cardiac region of compressive nature, and a persistent sleep disturbance.

She had suffered from hypertensive disease for about 10 years. She associated the development of the disease with prolonged difficult experiences of personal nature. At the time of admission and for the initial part of her stay in the hospital her blood pressure ranged within limits of 220/140-200/120 millimeters. On examination of the genitourinary sphere no pathological signs were found.

The data of chest fluoroscopy, electrocardiography and other examinations were normal.

She was given a course of electric sleep treatment -- 25 procedures (of these, the first nine were without turning on the current).

Clinical improvement occurred only after the procedures in which the pulsating current had been turned on were administered.

In Fig. 31 it is shown that during the base-line procedures the blood pressure did not decrease and sleep did not improve (for key see the description for Fig. 29). The use of electric sleep in which the current was turned on led to a decrease in blood pressure and to an improvement in sleep.

Patient N., age 29, skilled workman in an art shop, was in the hospital of the Institute of Therapy of the Academy of Medical Sciences USSR from 3 through 29 October 1955 with the following diagnosis: hypertensive disease, stage IIA.

She had been admitted with complaints of headache, general weakness, and insomnia. She had suffered from hypertensive disease since 1951. On examination in the hospital an increased uptake of the radioactive iodine by the thyroid

gland was noted. Otherwise, the laboratory and clinical examinations showed no essential abnormalities. At the time of admission and during the initial part of his stay in the hospital her blood pressure ranged within limits of 190/125-180/110 millimeters. Sleep was superficial, disturbed, and with nightmares.

Seventeen electric sleep procedures were given, of which the first six were without turning on the current. Clinical improvement was noted only after the patient began to receive electric sleep procedures in which the current was turned on.

At the end of the course of treatment a hypotensive effect was achieved: the blood pressure dropped to 140/80 millimeters; her night's sleep came up to 11 hours and became deeper and more refreshing. In Fig. 32 the dynamics of sleep and blood pressure are shown when procedures without the current were used and also those in which the current was turned on (for key see description accompanying Fig. 29).

Since the working hypothesis of the mechanism of action of the electric sleep assumes a normalizing effect of the pulsating current on the brain function the higher nervous activity of the patients was examined for the purpose of comparing the changes in the latter with the clinical observations of the patients during the course of electric sleep treatment of them.

G. V. Sergeyev investigated the higher nervous activity of the patients by A. G. Ivanov-Smolenskiy's method of speech reinforcement during the process of treating them with electric sleep. Here, the problem was to obtain comparative data concerning the course of the principal nervous processes in the patients before and after electric sleep treatment.

The rapidity of formation and consolidation of the conditioned motor reactions elaborated, the speed of formation of differentiating inhibition and the stability of the inhibitory reactions were investigated.

Through the investigations mentioned various disturbances in higher nervous activity were found in the majority of patients observed. A weakening of the stimulatory process of varying degrees, from delayed formation of a positive conditioned reflex or failure of consolidation of it to the inability to elaborate it without preliminary verbal instruction, was observed before treatment in patients with hyper-

tensive disease, stages IB and IIA. In some of these patients there were intersignal reactions aside from the delayed formation of the conditioned association.

In a number of patients a broad generalization of the stimulatory process was observed not only within the limits of the analyzer investigated (visual) but also with an irradiation of it to the neighboring (auditory) analyzer.

All this gives us the grounds for speaking of a weakness of the stimulatory process in patients with hypertensive disease. During the course of further investigations of these patients it was found that in many of them, in addition to the signs of weakness of the excitatory process noted, there were also other disturbances in the neurodynamics. These disturbances primarily characterize the condition of the inhibitory process and attest to a weakness of internal, active inhibition and a predominance of the processes of passive inhibition.

A weakening of internal inhibition with a difficulty of elaboration of differentiations and a failure of consolidation of inhibitory reactions were observed in many patients with hypertensive disease, stages IIA, IIB, and IIIA. Difficulties in the elaboration of the stereotype, particularly in revision of it, were observed in a considerable number of patients before treatment, which was evidence of a disturbance in the mobility of the principal nervous processes.

Sometimes, phasic states were observed before treatment in the patients examined, chiefly in the form of reactions of the ultraparadoxical phase type.

A study of the higher nervous activity of the patients after completing the course of electric sleep treatment made it possible to convince ourselves of the fact that in the great majority of observations a normalization of the neurodynamics occurred in parallel with the clinical improvement, which the author did not find in control investigations following the "base-line procedures."

In those patients in whom a reduction in blood pressure, restoration of sleep, and lessening of many other pathological signs characteristic of hypertensive disease were observed after electric sleep treatment there simultaneously occurred a normalization of higher nervous activity.

In patients with hypertensive disease, stages IIA and IIB, with pronounced clinical manifestations of it and a considerable duration of the disease there was no complete recovery of the disturbed processes of higher nervous activity; at the same time, the clinical results also proved to be insignificant. Essentially, they amounted to a certain improvement in the night's sleep and in the general feeling of well being. The hypotensive effect was not very definite. On examination of these patients a delayed formation of the stereotype and difficulties in revising it were found.

In generalizing on the experience of the clinicophysiological investigations on patients with hypertensive disease, stages IA, IB, IIA, IIB and IIIA, who have received a course of electric sleep treatment, it is important to note the following basic factors which, in G. V. Sergeyev's opinion, contribute to a greater understanding of the mechanism of the therapeutic action of electric sleep:

- 1) A regular decrease in blood pressure directly after the electric sleep procedure with a general hypotensive effect of it during the course of the electric sleep treatment;
- 2) Restoration to normal of the disturbed sleep function both with respect to its duration and depth; thereby, frequently the first to be recovered was the night's sleep; the sleep during the procedures themselves occurred during only subsequent electric sleep procedures;
- 3) Complete elimination or considerable lessening of a number of pathological sensations which usually accompany the course of the disease;
- 4) Normalization of conditioned-reflex activity of patients with hypertensive disease during the course of electric sleep treatment of them.

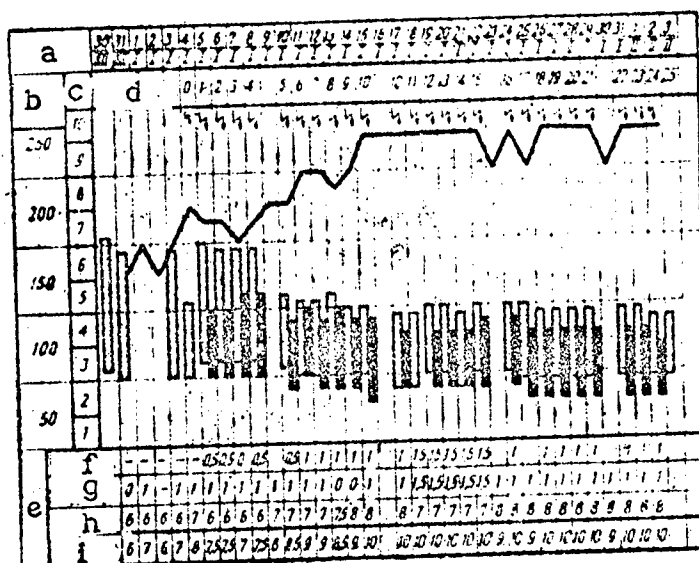


Fig. 29. Patient G. Hypertensive Disease IIA. Electric Sleep Treatment (explanation in text).
 a -- days of disease; b -- blood pressure in mm.;
 c -- hours of sleep; d -- electric sleep procedures; e -- sleep; f -- during procedure; g -- during day (after dinner); h -- at night; i -- for the 24 hours.

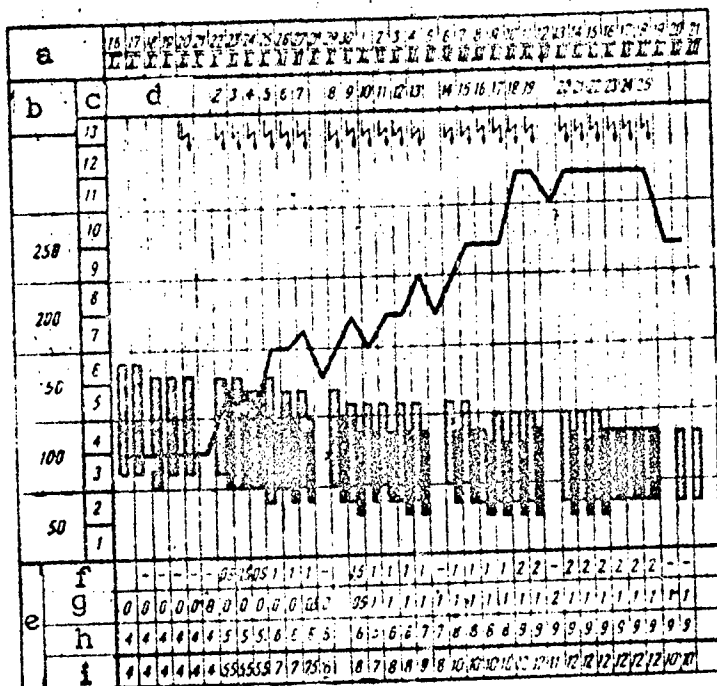


Fig. 30. Patient T. Hypertensive Disease. Electric Sleep Treatment (explanation in text).
 [Letter key same as in Fig. 29.]

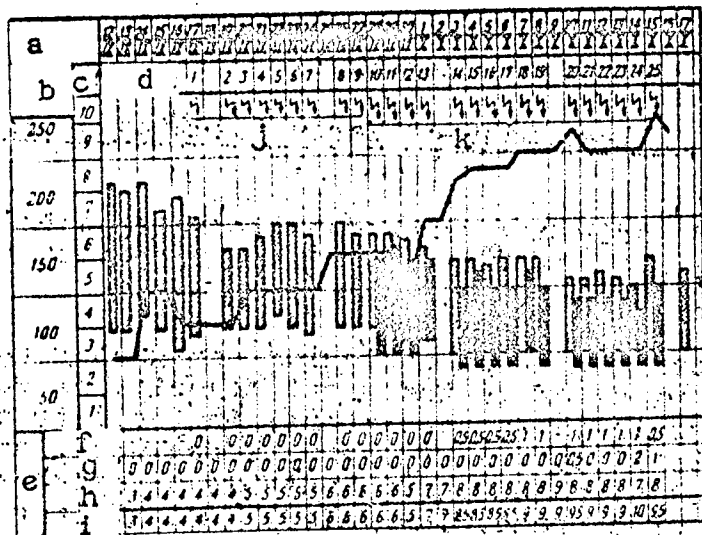


Fig. 31. Patient P. Hypertensive Disease Stage IIA. Electric Sleep Treatment (explanation in text).
 a -- days of disease; b -- blood pressure in mm.;
 c -- hours of sleep; d -- electric sleep procedure;
 e -- sleep; f -- during procedure; g -- during daytime (after dinner); h -- at night;
 i -- for the 24 hours; j -- without current;
 k -- with current.

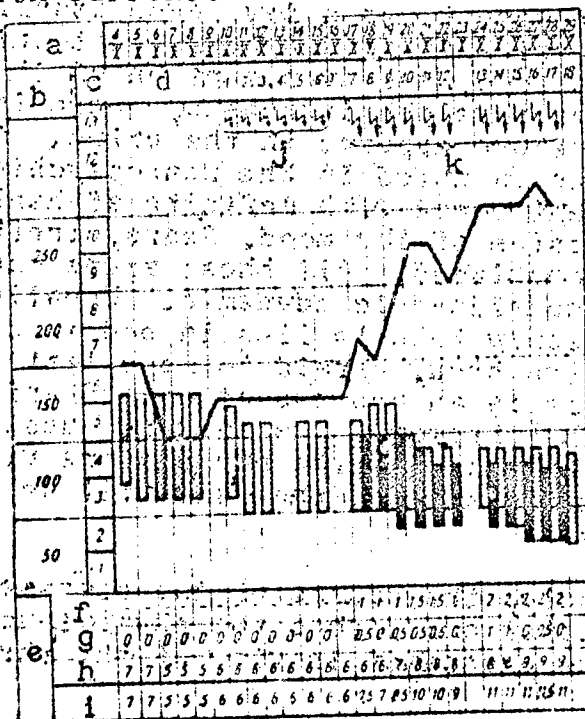


Fig. 32. Patient N. Hypertensive Disease. Electric Sleep Treatment (explanation in text).
 [Letter key same as in Fig. 31.]

CHAPTER IV

Electric Sleep Treatment of Early Toxemias of Pregnancy

Toxemias of early pregnancy constitute a pathological condition frequently associated with a pregnancy which is normal in all other respects.

In the presence of a physiological pregnancy and during the first few weeks of it the great majority of women note certain changes in their conditions: instability of the mood appears, irritability, tearfulness, sleepiness, and sleep disturbance (at times an insurmountable sleepiness; at other times, on the other hand, insomnia), "whims" in eating, nausea, vomiting, salivation, intolerance of various types of food and odors. Usually, these conditions are not permanent and completely disappear by themselves in the 16th-18th week of pregnancy.

In certain pregnant women, however, these signs assume a definitely pathological character: the nausea and vomiting increase and become more frequent; the vomiting sometimes occurs 10-15 or more times a day, even assuming a persistent nature. An aversion to food appears, not only to the type and odor of the food, but even mention of it produces vomiting. Loss of weight increases, there is a marked wasting, and acetone appears in the urine. A decrease in the psychic tone is noted in the neuropsychiatric condition of these pregnant women with definite asthenia, emotional ability, depression of the mood, fears, irritability, tearfulness, and touchiness. All these signs occur against a background of considerable adynamia. Usually, the pregnant woman who has early toxemia lies in bed in a stiff position, most often on the back, afraid to move lest she induce vomiting. There is an expression of suffering on the face, which is somewhat frozen. She answers questions in a quiet, depressed voice, accompanying her answers with tears and expressing doubts as to whether she will be healthy and can deliver a baby.

Not uncommonly, the course of the disease assumes a progressive character and forces the physicians to resort to terminating the pregnancy in view of the threat to the woman's life.

The problem of the causes and mechanism of occurrence of the early toxemias of pregnancy remain unclear to the present

time. A number of theories exist which explain the problems of etiology and pathogenesis of the early toxemias from different points of view -- hormonal, toxic, reflex, psychogenic, etc. The main defect in these theories is their one-sidedness and insufficient consideration of the leading role of the nervous system in the occurrence and formation of early toxemias as well as the significance of the environment, which under certain conditions, can be a factor influencing the body through the central nervous system, through its receptors, through the first and second signal system, and can produce pathological changes at times. Therefore, the therapeutic measures used in obstetrical practice in the early toxemias of pregnancy frequently are of a symptomatic nature and do not provide a sufficiently permanent therapeutic effect.

Only recently have methods of pathogenetic therapy of the early toxemias of pregnancy begun to be worked out. Among the latter should be mentioned, for example, sleep treatment, which when used in the form of pharmacologic sleep maintains all of the shortcomings characteristic of it.

In regarding electric sleep as one of the most physiological types of sleep treatment, we have suggested utilizing it also in the treatment of toxemias of the first half of pregnancy.

The initial observations along this line were made at the Institute of Obstetrics and Gynecology of the Ministry of Health USSR in 1951 (N. M. Liventsev, Z. A. Kirillova and Z. A. Venieri). Afterwards, the work was continued there by V. A. Avramova (head of the hospital -- Ye. P. Romanova). The observations were made on 50 patients, whereby electric sleep gave a beneficial effect in 48 of them, and pregnancy had to be interrupted in only two.

The women were admitted to the Institute during the early periods of pregnancy (five to seven weeks) for toxemia of pregnancy. In 20 of them the course of the toxemia was severe; frequent vomiting was noted (from five-six to ten-twelve times a day), considerable weight loss, and the presence of acetone in the urine. In the other 30 women the course of the disease was milder. In all, various neuropsychiatric disturbances were observed which may be characterized as asthenic, neurotic, and asthenic-depressive states. These conditions were labile and were definitely associated with fluctuations in the somatic sphere. A

characteristic of this group of patients was the fact that they all were hospitalized with the aim of somehow keeping their pregnancies, because they very much wanted to have children.

All the women complained of a depressed mood, expressing this with the following words: "my mood is depressed; I want to cry all the time; everything seems sad and there is no happiness," "I so much wanted to have a child, and now I am still not happy." Usually, there were complaints of severe weakness, loss of interest in everybody: "I can't think of anyone; I can't read; I can't assimilate anything; everything has faded; I want only one thing, to stop vomiting." The patients expressed the fear that they will not be able to carry their pregnancy to term, that the nausea and vomiting will never stop, that they won't ever be healthy again. Some of these women said that only the very great desire to have a child made them endure these torturous states.

We are presenting our observations as an illustration.

Patient Z., age 30, was admitted to the Institute of Obstetrics and Gynecology 12 January; was discharged 14 February 1951.

Diagnosis: pregnancy six weeks, vomiting of pregnancy.

Second pregnancy. At the time of admission, she vomited 12 times a day; she had weakness, loss of appetite, and nausea. There was acetone in her urine. Her mood was depressed for the most part, and she was melancholic. She wept all the time, could not concentrate, could not read, and said that she could not assimilate what she read. The first four days after admission to the hospital the patient was treated with enemas containing bromides, but her condition did not improve.

On 17 January electric sleep treatment was begun. At the time the current was turned on she noted a sticking in the area of the bridge of the nose. Soon thereafter, a condition of pleasant drowsiness occurred which passed into a deep sleep; at subsequent procedures she always slept. During the treatment the strength of the current was brought up to 14 ma. The patient's condition gradually improved, and after the sixth procedure the vomiting occurred only five times a day; after the eighth, once a day. The patient herself noted that following the electric sleep procedures

she became alert and that her disposition was good. After 17 procedures the patient was discharged in good condition in the 10th week of pregnancy.

Patient S., age 25, was admitted to the Institute of Obstetrics and Gynecology 2 January; discharged 1 February 1951.

Diagnosis: pregnancy five to six weeks; vomiting of pregnancy.

She was admitted with complaints of constant nausea, vomiting four or five times a day; loss of weight, decrease in appetite, general weakness, dizziness, irritability, tearfulness and touchiness. The patient wept on account of trifles; she did not want to move or to think; she had some kind of indefinite fear. During the first 10 days treatment was given with enemas containing bromides, but her condition became worse, and the vomiting continued to be persistent; the patient lost weight, and acetone appeared in the urine.

Beginning with 17 January the use of electric sleep was begun; the current strength was within limits of eight to ten ma, the frequency was one and a half oscillations a second. During the procedure a slight sticking was noted in the area of the supraorbital arches, and then a mild drowsiness appeared, which was maintained throughout the procedure. After the fourth procedure she noted that she had become considerably more active and that she was less troubled by nausea and vomiting; her mood became more even; during the procedure she experienced a feeling of pleasant rest which passed into drowsiness; she slept even after the current was turned off. After the sixth procedure the nausea and vomiting became less frequent, and after the eighth procedure, the vomiting almost stopped. Sometimes she was nauseous but to a much lesser degree; she developed an interest in reading, and said that she began to miss her home, whereas everything had been indifferent to her up to that time. Fifteen electric sleep procedures were given; at the last procedures the current strength was brought up to 15 ma. Her general condition was good, lively; her mood was even, alert. On 1 February she was discharged home in good condition.

Patient B., age 31, was admitted to the Institute of Obstetrics and Gynecology 15 January; was discharged 30 January 1951.

Diagnosis: pregnancy eight weeks; vomiting of pregnancy; salivation. Second pregnancy. The course of the present pregnancy had been complicated by nausea for five weeks to which had then been added salivation. During the past month she had lost four kilograms in weight. Albumin appeared in her urine. She secreted up to 700 cubic centimeters of saliva a day. Her mood was very much depressed. The patient wept all the time, did not believe in her recovery nor in the treatment. Food and the appearance of it caused disgust, and she had a complete absence of the desire to eat. Recently, her sleep had been very poor, and the patient dreamed that she was eating some kind of "nasty food."

Electric sleep treatment was suggested for the patient. On 17 January the dosage of the pulsating current on the brain was determined. The current strength was within limits of five ma; the frequency, one and a half oscillations a second. At the time of turning on the current the patient became excited, and stated that it was sticking her everywhere; she was anxious. Then, she gradually quieted down, and at the end of the procedure offered no complaints.

On 18 January she felt good during the electric sleep procedure; she had no nausea and her salivation became less; she secreted 500 cubic centimeters of saliva per day. After the third procedure the salivation decreased still further; she had no nausea, and her appetite improved. After the fifth procedure the patient noted that her salivation had completely stopped, and that her appetite had come back. During the electric sleep procedure she had drowsiness and also a state of pleasant rest. After the eighth procedure the patient noted that she was in a good, alert condition and that she wanted to go home; she felt entirely healthy. Fifteen electric sleep procedures were given. The patient was discharged in good condition in the 12th week of pregnancy.

Electric sleep treatment gave a beneficial effect in other patients also. The number of procedures given ranged from 5 to 20. The dynamics of the disease during the course of treatment were usually characterized by the fact that from the beginning the general condition and disposition improved; the vomiting and nausea gradually stopped.

As is known, nausea and vomiting in pregnant women later stops even with ordinary treatment, but electric sleep accelerates the advent of a normal condition. All the patients were discharged between 10 and 12 weeks of pregnancy,

and they all delivered healthy children at term.

Improvement in the neuropsychiatric condition, the cessation of vomiting, nausea and salivation show that electric sleep is an effective therapeutic method also in the toxemias of pregnancy, and that it makes it possible to administer the treatment without the use of narcotics, which are particularly undesirable in the toxemias of pregnancy. In addition, electric sleep treatment shortens the time that the patients are in the hospital to 10-15 days.

Conclusion

Electric sleep is a condition of sleep inhibition produced by the application of an electric current; it constitutes a substantial supplement to our arsenal of therapeutic measures. Electric sleep, which we have studied since 1947, should be distinguished strictly from electronarcosis, which we also studied earlier.

Electronarcosis is produced by a current of comparatively great strength and is accompanied by marked sensations which are preserved distinctly in the memory of the patients; this contributes to the occurrence of a very negative attitude towards this procedure in the patients.

Electric sleep, which is produced by a special apparatus which we have developed which gives weak rhythmical stimulation, not only does not produce unpleasant sensations in the patients but, as the patients themselves characterize it, is also a peaceful, pleasant procedure which produces a feeling of freshness, alertness, and to which they are attracted. Dreams during electric sleep are of a pleasant nature, even when they have nightmares at night.

We gave considerable attention to the elucidation of the physiological nature of electric sleep. The investigations led us to the belief that the direct effect of the pulsating current on the brain produces the condition of inhibition, which is very similar to although not identical with natural sleep. We have called this condition electric sleep, using the terminology adopted in the laboratories of I. P. Pavlov with respect to sleep produced by weak rhythmical stimulation of the skin. (F. P. Mayorov. History of the Teaching on Conditioned Reflexes. Published by Academy of Medical Sciences USSR, Moscow, 1948, page 250.)

Electric sleep has its own definite physiological characteristics which are very similar to those observed in natural sleep; the pulse and respiration becomes slower, and the previously disturbed respiratory rhythm and amplitude become normal.

A wave-form process similar to the periodic type of respiration may be observed in the hypnotic phases with the gradual diffusion of the inhibitory process.

Plethysmograms during electric sleep have a tendency to rise. While before electric sleep an inhibition of the second- and third-order waves is noted on the plethysmogram, during electric sleep they gradually appear.

The dynamics of the conditioned and unconditioned defensive and vascular reflexes are similar to what is observed in physiological sleep: from the beginning a gradual inhibition occurs of the conditioned and then of the unconditioned reactions, whereby hypnotic phases may be observed in the dynamics of electric sleep -- equalizing, paradoxical and ultraparadoxical.

The dynamics of electrical activity of the brain are also very similar to what occurs in physiological sleep: slow waves gradually appear, which then become the dominant rhythm, which attests to the development of an inhibitory state in the cerebral cortex. At the same time, as experiments on animals have shown, the optimum excitation rhythm appears in the electrothalamogram. Owing to the great reactivity of the cortical cells and the inductive relationships between the cerebral cortex and the subcortex sleep inhibition develops under the effect of the pulsating current.

Biochemical examinations are evidence that a decrease in the oxidative processes in electric sleep is, in general, less than in physiologic sleep. Sometimes, even an increase in the oxidative processes is noted.

Electric sleep has proved to be a mild and completely harmless method of treatment which does not produce any complications. For the purpose of intensifying its effect we have in certain variants used the combination of electric sleep with other therapeutic influences: bromides, caffeine as well as insulin (in the treatment of schizophrenia). Combination of electric sleep with insulin has made it possible to use small doses without resorting to insulin coma.

Electric sleep has found extensive application in the hospital of internal diseases in the treatment of patients with peptic ulcer and hypertensive disease as well as in obstetrical practice, where it has been successfully utilized in the treatment of toxemias of the first half of pregnancy. In recent years, the application of it has already transcended the limits of solitary scientific research institutions.

According to existing information, electric sleep is being used at present in 68 therapeutic institutions of the Soviet

Union: in 19 republic, kray and oblast neuropsychiatric hospitals (KazakhSSR, TatarASSR, Omskaya, Novosibirskaya, Tambovskaya, Saratovskaya, Permskaya, Vladimirskaia, Kostromskaya. Oblasts and others), in 11 psychiatric hospitals of medical institutes (Kuybyshev, Dnepropetrovsk, L'vov, Perm, Alma-Ata, and others).

The application of the electric sleep method to dispensary practice should also be noted as a very valuable and promising beginning. V. A. Menskaya in the Neuropsychiatric Dispensary of Krasnopresnenskiy Rayon of Moscow (chief physician -- N. I. Ivanova), whose experience has shown the complete possibility of applying electric sleep under conditions of a neuropsychiatric dispensary, has made a valuable start in this direction. According to the observations of this dispensary, the electric sleep method is not only indicated and possible in a neuropsychiatric dispensary but is an adequately effective variant of sleep therapy under outpatient conditions. Among the patients treated on an outpatient basis with electric sleep there were those who had been suffering from schizophrenia from 8 to 25 years. After a course of treatment their asthenic, asthenic-neurotic and depressive onlays were eliminated or considerably lessened. Electric sleep treatment is also being used in other neuropsychiatric dispensaries in Moscow as well as in the Neuropsychiatric Dispensary of Yerevan.

It should be noted that thousands of electric sleep procedures performed in general hospitals, institute hospitals, and dispensaries have shown, on the one hand the complete harmlessness of this method, and, on the other hand, its effectiveness in the treatment of a number of neuropsychiatric and internal diseases. All this serves as the grounds for more extensive incorporation of the electric sleep method into the practice of therapeutic-prophylactic institutions.

Everything which has been presented gives us adequate grounds for supposing that the pulsating current plays the leading part in the complex mechanism of the therapeutic action of electric sleep. As a result of the effect of the pulsating current on the central nervous system deeper and more complex changes occur in the body of the patient than those which can be achieved by several additional hours of sleep produced by various neutral stimuli like, for example, the flickering of a lamp, the beat of a metronome, the sound of falling rain.

Control observations with the performance of "base-line"

procedures are an essential confirmation of the position expressed concerning the role of the pulsating current in the complex mechanism of the physiological effect of electric sleep. The role of the conditioned reflex factor particularly the psychogenic factor in the general complex of the procedure constitutes a secondary factor of little significance.

Bibliography

1. Abuladze K. S. Sleep from Negative Induction. In the book: "Sleep Problems. An Anthology." Moscow, 1954, pages 147-153.
2. Andreyev F. A. Functional Cerebral Pathology in Internal Diseases and Prolonged Sleep Therapy of Them. Works of the Combined Session Devoted to the 10th Year Since the Date of Death of I. P. Pavlov. Published by the Academy of Medical Sciences. USSR, 1948, page 166.
3. Asratyan E. A. New Data on the Physiology of Adaptive Phenomena Where the Nervous System Has Been Injured. Reports of the Seventh All-Union Congress of Physiologists. Published by the Academy of Medical Sciences, USSR, 1947.
4. Asratyan E. A. The Theory and Practice of Protective Inhibition and Its Curative Role. Fiziologicheskii zhurnal SSSR [Journal of Physiology of the USSR], 1946, Vol 32, No 1, page 34.
5. Asratyan E. A. The Theory and Practice of Pavlovian Protective-Curative Inhibition. Works of the Combined Session Devoted to the 10th Year Since the Date of Death of I. P. Pavlov. Published by the Academy of Medical Sciences USSR, 1948, page 152.
6. Afanas'yev D. V. Experience in the Use of Electronarcosis in the Mentally Ill. Vrachebnoye delo [Physician's Affairs], 1951, No 3.
7. Beylin P. A. From Pharmacologic Sleep to Physiologic Sleep. Vrachebnoye delo, 1951, No 2, page 135.
8. Belitskiy G. Yu. The Problem of Electric Sleep. In the book: "Problems of Neuropsychiatry." Abstracts of his own scientific works 1949-1951. Leningrad, 1954, pages 175-177.
9. Berkhoon A. S. Electric Sleep Treatment in the TsNIIPP [Central Scientific Research Institute of Prosthetics and Prosthesis Construction] Hospital. In the book: "Reports of the Fourth Scientific Session of the Central Institute of Prosthetics and Prosthesis Construction." Moscow, 1955, pages 130-132.

10. Berkhon A. S. Experience of the TsNIIPP in Electric Sleep Therapy of Amputees With Phantom Pains and Indolent Trophic Ulcers. In the book: "Reports of the Third Scientific Session of the Central Institute of Prosthetics and Prosthesis Construction." Moscow, 1953, pages 71-73.
11. Beyul Ye. A. and Limcher L. F. Application of Electric Sleep in Combination With Dietary Therapy in Hypertensive Disease. Voprosy pitaniya [Problems of Nutrition], 1954, No 6, pages 10-15. Bibliography.
12. Birman B. N. The Role of Hypnotic and Sleep Inhibition in the Pathogenesis and Therapy of Neurotic Syndromes. Zhurnal vysshey nervnoy deyatelnosti imeni I. P. Pavlova [Journal of Higher Nervous Activity imeni I. P. Pavlov], 1951, Vol 1, No 1, page 67.
13. Bykov K. M. "The Cerebral Cortex and the Internal Organs." Second Edition. Medgiz, 1947.
14. Varshamov L. A. Sleep Therapy of Patients With Hypertensive Disease. Terapevticheskiy arkhiv [Therapeutic Archives], 1952, Vol 24, No 3, pages 6-14.
15. Vasilevskiy V. M. Material on the Physiology of Subminimal Stimuli in the Neuro-Muscular System of Warm-Blooded Animals. In the collection: "Reports at the Seventh All-Union Congress of Physiologists, Biochemists and Pharmacologists." Medgiz, 1947, page 30.
16. Vasil'yev L. L. and Kalendarov G. S. The Physicochemical Basis of the Effect of Current on the Nervous System. In the collection: "Electric Narcosis." Published by VIEM [All-Union Institute of Experimental Medicine], 1937, page 53.
17. Vasil'yev L. L., Lapitskiy D. A. and Petrov F. P. "From Electrotonus to Electronarcosis." Published by VIEM, 1937, page 81.
18. Vvedenskiy N. Ye. The Origin and Nature of Nerve Narcosis. Obozreniye psikiatrii [Psychiatric Review], 1902, No 2, page 3.
19. Vvedenskiy N. Ye. Excitation, Inhibition and Narcosis. "Selected Works," part 2, 1951.

20. Verigo B. F. The Problem of the Effect of Interrupted and Continuous Galvanic Currents on Nerve. Dissertation. VMA [Military Medical Academy], 1888.
21. Gartsshteyn N. G. Phasic Phenomena and the Conditions of Their Occurrence in the Cerebral Cortex of Patients With Reactive Depression. In the collection: "Abstracts of Scientific Works. Medico-Biological Sciences." Published by the Academy of Medical Sciences USSR, 1949, No 7, page 140.
22. Gilyarovskiy V. A. The Problem of Therapy at the Current Stage of Development of Soviet Psychiatry. Nevropatologiya i psikhiaetriya [Neuropathology and Psychiatry], 1950, Vol 19, No 3, page 24.
23. Gilyarovskiy V. A. I. P. Pavlov and Psychiatry. Nevropatologiya, psikhiaetriya i psikhogigiena [Neuropathology, Psychiatry and Mental Hygiene], 1936, Vol 6, No 5, pages 904-909.
24. Gilyarovskiy V. A. The Dynamics of Schizophrenia Under the Influence of Prolonged Narcosis. Sovetskaya psikhonevrologiya [Soviet Neuropsychiatry], 1936, No 4.
25. Gilyarovskiy V. A. The Clinic and Psychopathology of Prolonged Narcosis. Arkhir biologicheskikh nauk [Archives of the Biological Sciences], 1936, Vol 42, No 1-2, pages 89-99.
26. Gilyarovskiy V. A., Sluchevskiy I. F., Liventsev N. M., Kirillova Z. A. The Problem of Electric Sleep, Electric Narcosis and Electric Lethargy. Klinicheskaya meditsina [Clinical Medicine], 1948, No 6.
27. Gilyarovskiy V. A., Liventsev N. M., Kavyrshin A. Ye., Kirillova Z. A. Electronarcosis and Electric Sleep in the Therapy of Mental Diseases. Collection "Sleep Treatment of Mental Diseases." Medgiz, 1950.
28. Gilyarovskiy V. A., Segal' Yu. Ye., Liventsev N. M. and Kirillova Z. A. The Problem of the Mechanism of the Therapeutic Effect of Electric Sleep. In the book: "The Institute of Physiology. Theses." Moscow, 1954, pages 16-20.
29. Gilyarovskiy V. A., Kirillova Z. A. Clinical and Physio-

- logical Data of Electric Sleep Therapy of Mental Diseases. In the book: "Theses of the First Scientific-Practical Conference of Neuropsychiatrists of Kuybyshev and Kuybyshevskaya Oblast." Kuybyshev, 1954, pages 44-46.
30. Gilyarovskiy V. A., Liventsev N. M., Segal' Yu. Ye., Kirillova Z. A. Electric Sleep and Its Application to the Treatment of Mentally Ill Patients. The Application of Electronarcosis and Electric Sleep in the Psychiatric Hospital. In the book: "Sleep Problems. An Anthology." Moscow, 1954, pages 405-422.
 31. Gilyarovskiy V. A., Liventsev N. M., Segal' Yu. Ye., Kirillova Z. A. "Electric Sleep (A Clinical-Physiological Investigation)." First Edition. Medgiz, 1953.
 32. Glazov V. A. The Effect of Anesthetizing Currents on the Neuropsychiatric Reactions. Arkhiy biologicheskikh nauk [Archives of Biological Sciences], 1936, Vol 41, No 1, page 103.
 33. Glazov V. A. New Lines in the Therapy of Mental Diseases. Nevrologiya i psikhatriya [Neurology and Psychiatry], 1947, Vol 16, No 6, page 77.
 34. Glazov V. A., Kalendarov G. S., Lapitskiy D. A. and Petrov F. P. Orientative Experiments With Electric Narcosis of Man. In the collection: "Electric Narcosis." Published by VIEM, 1937, page 109.
 35. Golyanitskiy I. A. Narcosis Under the Influence of the LeDuc Current (Experimental Investigation). Separata of Works of the Pharmacological Institute of Moscow University. 19, 12.
 36. Golyanitskiy I. A. Narcosis Under the Influence of the LeDuc Current. Meditsinskoye obozreniye [Medical Review], 1912, Vol 77, page 869.
 37. Diordiyenko I. A. Experience in the Application of Electric Sleep to the Clinic of Nervous Diseases. Zhurnal nevropatologii i psikhatrii imeni S. S. Korsakova [Journal of Neuropathology and Psychiatry imeni S. S. Korsakov], Vol LVI, No 4, 1956, pages 333-336.
 38. Dymetskaya L. V. Experience in the Experimental Study of the Neurodynamics of Electric Sleep. In the Book:

- "Conference on the Problem of Higher Nervous Activity. Theses and Abstracts of Reports." Moscow-Leningrad, 1953, pages 82-83.
39. Dymetskaya L. V. Electric Sleep as a Method of Protective Therapy. Self-referenced Candidate's Dissertation. Molotov, 1955.
 40. Ivanov-Muromskiy K. A. Experiment in the Use of Electronarcosis in Animals. Vrachebnoye delo, 1953, No 5, pages 471-472.
 41. Ivanov-Muromskiy K. A. and Roytenburg S. R. The Application of Electric Sleep to the Practice of Rural Public Health. Vrachebnoye delo, 1956, No 1, pages 73-74.
 42. Ivanov-Muromskiy K. A. Low Frequency Pulsating Current as a Therapeutic Factor. Information Bulletin No 1, Andreyevo-Ivanovo, 1956.
 43. Ivanov-Smolenskiy A. G. Experimental-Clinical Investigation of Protective Inhibition. Arkhib biologicheskikh nauk, 1936, No 1-2, page 59.
 44. Ivanov-Smolenskiy A. G. The Interaction Between the First and Second Signal Systems. Abstracts of Scientific Research Works in Medico-Biological Science. Published by the Academy of Medical Sciences USSR, 1947.
 45. Ivanov-Smolenskiy A. G. Academician I. P. Pavlov's Teaching of Protective Inhibition and Prolonged Narcosis in Schizophrenia. Works of the Third All-Union Congress of Neuropathologists and Psychiatrists, 1937, No 2.
 46. Ivanov-Smolenskiy A. G. Experimental and Clinical Research in the Field of Protective Inhibition and Prolonged Therapeutic Sleep. Zhurnal vysshey nervnoy deyatel'nosti [Journal of Higher Nervous Activity], 1951, Vol 1, No 3, pages 347-361.
 47. Ivanov-Smolenskiy A. G. Outlines of the Pathophysiology of Higher Nervous Activity. Medgiz, 1949.
 48. Ivanov-Smolenskiy A. G. Pathophysiological Research on Higher Nervous Activity in a Psychiatric Hospital. Arkhib biologicheskikh nauk, 1939, No 1, page 70.

49. Kalendarov G. S. Electric Narcosis. In the collection: "Electric Narcosis." Published by VIEM, 1937, page 5.
50. Kalendarov G. S., Lepitskiy D. A. and Petrov F. P. The Problem of the Nature of the Physiological Effect of Interrupted Currents on the Nervous System. In the collection: "Electric Narcosis." Published by VIEM, 1937, page 123.
51. Kalendarov G. S. and Lebedinskaya Ye. I. The Physiologic Mechanism and Stage of Development of Electric Narcosis. Fiziologicheskii zhurnal SSSR, 1953, Vol XXXIX, pages 146-152.
52. Kaminskiy S. D. Sleep and Its Salutary Role in the Light of the Teaching of I. P. Pavlov on Protective Inhibition. Sovetskaya meditsina, 1949, No 9, page 12.
53. Kaminskiy S. D. I. P. Pavlov's Teaching About Protective Inhibition and Its Role in Medicine. In the collection: "News of Medicine." Published by the Academy of Medical Sciences USSR, No 14, Vysshaya nervnaya deyatel'nost' [Higher Nervous Activity], 1949, page 53.
54. Kerbikov O. V. and Il'yina V. N. Light Electric Stimulation Therapy in the State of Narcosis. Zhurnal neuropatologii i psikhiiatrii imeni S. S. Korsakova [Journal of Neuropathology and Psychiatry imeni S. S. Korsakov], 1952, VII, 3, pages 45-53.
55. Kirichinskiy A. R. Transcerebral Therapy of Nervous System Diseases. In the book: "Works of the Kiev Neuropsychiatric Institute." Medgiz UkrSSR, 1935, Vol 4, page 167.
56. Kirillova Z. A. The Neurodynamics of Higher Nervous Activity in the Electric Sleep Treatment of Patients with Schizophrenia. In the book: "All-Union Scientific Conference Devoted to the S. S. Korsakov Centennial. Theses of Proceedings." Moscow, 1954, pages 52-53.
57. Kirillova Z. A., Korganova A. N. and Skuin' E. Ya. Experiment in the Application of Electric Sleep in a Children's Psychiatric Hospital. Voprosy pediatrii [Problems of Pediatrics], 1953, XXI, 2, pages 18-21.
58. Kirillova Z. A. Electric Sleep and Its Combination with Insulin in the Therapy of Mental Diseases. Self-Refer-

- enced Dissertation. Moscow, 1954, 14 pages.
59. Kirillova Z. A. Electric Sleep and Its Combination with Insulin in the Therapy of Mental Diseases. Dissertation. Moscow, 1953, 317.
 60. Kogan R. M. The Penetration of Iodine Ions Into the Cranial Cavity During Ionization. Zhurnal nevropatologii i psikhatrii imeni S. S. Korsakova, 1927, 3, page 239.
 61. Korkina M. V. Electric Sleep Treatment of Mental Diseases. Self-Referenced Dissertation. Moscow, 1953, 14 pages.
 62. Korkina M. V. Electric Sleep Treatment of Mental Diseases. Dissertation. Moscow, 1953, 360 pages.
 63. Korkina M. V. Experience in the Treatment of Schizophrenic Patients with Electric Sleep. In the book: "All-Union Scientific Conference Devoted to the S. S. Korsakov Centennial. Theses." Moscow, 1954, pages 53-54.
 64. Krasnogorskiy N. I. Development of the Knowledge of Physiologic Activity of the Brain in Children. OGIZ [State United Publishing Houses], 1939.
 65. Kreps, Ye. M., Shipovalov M. S., Bolotinskiy Ye. A. The Oxyhemometer and Oxyhemometry. Byulleten' eksperimental'noy biologii i meditsiny [Bulletin of Experimental Biology and Medicine], 1951, 7, page 60.
 66. Kuznetsov A. M. The Application of Electric Sleep to Rural Public Health. Information Bulletin No 1. Andreyev-Ivanovo, 1956.
 67. Lapitskiy D. A. and Petrov F. P. Electric Narcosis of the Frog Produced by a Direct Current. In the collection: "Electric Narcosis." Published by VIEM, page 67.
 68. Lapitskiy D. A. and Petrov F. P. Local Anesthesia Produced by the Direct Electric Current. In the collection: "Electric Narcosis." Published by VIEM, 1937, page 73.
 69. Lapitskiy D. A. and Petrov F. P. Electronarcosis of Warm-Blooded Animals. In the collection: "Electric Narcosis." Published by VIEM, 1937, page 101.
 70. Litmanizova L. V. Vvedenskiy's Rules and Regulations

- in the Electrical Activity of Excitable Entities. Leningrad, 1949.
71. Livanov M. N. Change in the Cortical Action Currents During the Elaboration of Defensive Conditioned Reflexes. Seventh All-Union Congress of Physiologists, Biochemists and Pharmacologists. Reports.. Medgiz, 1947, page 179.
 72. Livanov M. N. Analysis of Bioelectric Waves in the Cerebral Cortex of the Rabbit. Sovetskaya nevrologiya, psikiatriya i psikhologiya, 1934, No 11-12, page 98.
 73. Liventsev N. M., Kirillova Z. A., Venieri Z. A. The Application of Electric Sleep to the Obstetrical Hospital in the Light of I. P. Pavlov's Teaching on Protective Inhibition. Zhurnal akusherstva i ginekologii [Journal of Obstetrics and Gynecology], 1951, No 5, page 13.
 74. Liventsev N. M. The Mechanism of the Narcotic and the Hyperkinetic Reaction in Electronarcosis. Fiziologicheskii zhurnal SSSR, 1951, No 6, page 703.
 75. Liventsev N. M. Study of Certain Reactions of the Organism During the Action of a Pulsating Current on the Central Nervous System (Electronarcosis and Electric Sleep). Dissertation. Vol. 1-3, Moscow, 1952.
 76. Liventsev N. M., Vozdvizhenskaya V. S. and Strelkova A. F. The Pulsating Current Treatment (Electric Sleep) of Patients with Sequelae of Traumatic Injury of the Brain. Zhurnal nevrologii i psikiatrii imeni S. S. Korsakova, 1954, 54, 4, pages 328-335.
 77. Liventsev N. M. The Mechanism of Different Phases of Electronarcosis in the Light of I. P. Pavlov's Teaching. Fiziologicheskii zhurnal SSSR, 1953, XXXIX, 2, pages 153-158.
 78. Marshak M. Ye. Neural Mechanisms of Correlation Between Respiration and Circulation. Byulleten' eksperimental'noy biologii i meditsiny [Bulletin of Experimental Biology and Medicine], 1953, No 8.
 79. Mantserova A. I. Experience in Electric Sleep Therapy in a Psychiatric Hospital. Zdravookhraneniye Kazakhstana [Public Health of Kazakhstan], 1954, 6, pages 32-36.

80. Magnitskiy A. N. Interrelationship of the Teachings of I. P. Pavlov and N. Ye. Vvedenskiy on Matters of Inhibition. Zhurnal vysshey nervnoy deyatel'nosti imeni I. P. Pavlova, 1951, No 1, page 128.
81. Mayorov F. P. Phases of Sleep. Sovetskaya nevropsikhiatriya [Soviet Neuropsychiatry], 1941, No 6.
82. Mayorov F. P. History of the Science of Conditioned Reflexes. Published by the Academy of Sciences USSR, 1948.
83. Mayorov F. P. New Data of an Experimental Study of Sleep and Transitional States in Man. Theses of Proceedings of the Fifth Conference on Physiological Problems Devoted to the Memory of I. P. Pavlov. Published by the Academy of Sciences USSR, 1939.
84. Megrobayan A. A. and Mananzryan E. Ya. Experience in the Use of Electric Sleep Under Dispensary Conditions. Works of the First Scientific Session of the Armenian Society of Neuropathologists and Psychiatrists. Yerevan, 1956, pages 190-197.
85. Mikhaylova O. A., Moiseyev Ye. A. and Tonkikh A. V. Sleep After Electrical Stimulation of the Subcortical Ganglia. Fiziologicheskiy zhurnal SSSR, 1939, No 4, page 389.
86. Moiseyev Ye. A. and Tonkikh A. V. The Role of the Sympathetic Nervous System in the Phenomena of Sleep During Electrical Stimulation of the Subcortical Ganglia. Fiziologicheskiy zhurnal SSSR, 1939, No 4, page 394.
87. Pavlov I. P. "The Physiology and Pathology of Higher Nervous Activity." Gosmedizdat [State Medical Publishing House], 1930.
88. Pavlov I. P. Lectures on the Work of the Cerebrum. "Complete Collection of Works." Vol IV, Published by the Academy of Sciences USSR, 1949.
89. Pavlov I. P. Twenty-Years' Experience in the Objective Study of Higher Nervous Activity (Behavior) of Animals. "Complete Collection of Works." Vol III. Published by the Academy of Sciences USSR, 1949.
90. Pavlov I. P. and Voskresenskiy L. N. Material on the

Physiology of Sleep. Report to the Petrograd Biological Society. Separatum, 1915.

91. Pavlov I. P. and Petrova M. K. The Physiology of the Hypnotic State in a Dog. Works of the Physiological Laboratory imeni I. P. Pavlov. No 4, 1932.
92. Petrova M. K. Narcotic Sleep, Hypnotic Sleep and Ultra-boundary Protective Inhibition and Their Therapeutic Significance. Works of the Combined Session Devoted to the Tenth Year Since the Day of Death of I. P. Pavlov. Published by the Academy of Sciences USSR, 1948.
93. Petrova M. K. Latest Data on the Mechanism of Action of Bromide Salts on Higher Nervous Activity and on the Therapeutic Application of Them on Experimental Grounds. Published by VIEM, 1935.
94. Protopopov V. P. "Pathophysiological Basis of Rational Therapy of Schizophrenia." Kiev, 1946.
95. Protopopov V. P. Principles and Methods of Protective Therapy. Works of the Second All-Union Congress of Neuropathologists and Psychiatrists, No 2, 1937.
96. Rasin S. D. and Vernikova R. A. Experience in the Use of Electric Sleep and Conditioned Reflex Sleep in Mentally Ill Patients. Vrachebnoye delo, 1952, No 5, page 394.
97. Rasin S. D., Golubchik A. A. and Fabish G. G. Further Observations on the Effectiveness of Electric Sleep and Conditioned Reflex Sleep. Zhurnal nevropatologii i psikiatrii imeni S. S. Korsakova, 1954, No 1, pages 14-16.
98. Robiner I. S. The Physiological Mechanism of Action of the Low Strength and Low Frequency Pulsating Current. Zhurnal vysshey nervnoy deyatel'nosti imeni I. P. Pavlova, 1956, Vol VI, No 1.
99. Segal' Yu. Ye. and Liventsev N. M. The Physiological Characteristics of the Therapeutic Action of Electric Sleep. In the book: "Nineteenth Scientific Session of the Ukrainian Neuropsychiatric Institute Devoted to the 300th Anniversary of the Reunion of the Ukraine with Russia. Theses of Proceedings." Khar'kov, 1954, pages 98-99.

100. Segal' Yu. Ye. and Liventsev N. M. The Physiological Nature of Electric Sleep. Vrachebnoye delo, 1953, No 11, pages 977-982.
101. Segal' Yu. Ye. The Neurodynamics of the Vascular Reactions in the Hallucinatory-Paranoid Type of Schizophrenia. Second Report. Disturbances of the Interaction of Vascular and Respiratory Reactions in Schizophrenia. Zhurnal nevropatologii i psikiatrii imeni S. S. Korsakova, 1955, No 4.
102. Segal' Yu. Ye., Skuin' E. Ya. and Kirillova Z. A. The Therapeutic Effect of Electric Sleep, Its Physiological Mechanisms and the Dynamics of the Biochemical Changes. In the book: "Theses and Self-Referenced Proceedings of the Annual Conference of the Institute of Psychiatry of the Ministry of Health USSR." Moscow, 1955, page 47.
103. Servit Z., Buresh Ya., Bureshova O. and Petran' M. K. The Problem of Electronarcosis and Electric Sleep. Chekhoslovatskaya fiziologiya [Czechoslovakian Physiology], Prague, 1953, 2, 4, pages 337-346.
104. Servit Z. The Problem of the Mechanism of the Hypnotic Action of the Pulsating Current. Chekhoslovatskaya fiziologiya, Prague, 1954, 3, 3, pages 302-305.
105. Servit Z. The Problem of the Physiology of Electric Sleep. The Hypnotic Effect of an Alternating Sinusoidal Current. Chekhoslovatskaya fiziologiya, Prague, 1954, 3, 2, pages 206-216.
106. Servit Z. The Physiology of Electric Sleep. The Hypnotic Effect of a Pulsating (Interrupted) Direct Current. Chekhoslovatskaya fiziologiya, Prague, 1954, 3, 3, pages 296-301.
107. Sergeyev G. V. Electric Sleep Therapy of Patients with Hypertensive Disease Under the Control of Investigation of the Higher Nervous Activity. In the book: "Works of the Joint Scientific Session of the Institute of Physiology imeni I. P. Pavlov of the Academy of Sciences USSR and the Institute of Clinical and Experimental Cardiology of the Academy of Sciences GeorgSSSR, Leningrad, 1955.
108. Sergeyev G. V. Experience in the Electric Sleep Treatment of Patients with Hypertensive Disease. Voprosy

kurortologii, fizioterapii i lechebnoy fizkul'tury
[Problems of Health Resort Science, Physiotherapy and
Therapeutic Physical Culture], 1956, No 4, page 39.

109. Sirotinin N. N. The Problem of the Cortical Regulation of Respiration. In the book: "Theses of Proceedings at the Conference on the Problems of Cortico-Visceral Pathology." Leningrad, 1953.
110. Trofimov N. M. The Problem of the Cortical Regulation of Respiration. Fiziologicheskiiy zhurnal SSSR imeni I. M. Sechenova, Vol XXXVIII, 1952, No 5, pages 584-593.
111. Usqv A. G. The Problem of Cortical Regulation of Respiration and Old Age. Fiziologicheskiiy zhurnal SSSR, 1952, Vol XXXVIII, No 5, pages 576-584.
112. Khadlik I. Clinical Experience in the Use of Electric Sleep. Abstract Journal of Biology. Prague. Abstract No 28787.
113. Chagovets V. Yu. Outline of Electrical Phenomena in Living Tissues from the Point of View of the Latest Physicochemical Phenomena. Dissertation. St. Petersburg, 1903.
114. Chagovets V. Yu. - The Inhibitory Effect of an Interrupted Galvanic Current on the Central Nervous System. Obozreniye psikhiiatrii, neurologii i eksperimental'noy psikhologii [Review of Psychiatry, Neurology and Experimental Psychology], 1906, No 1, page 18.
115. Shamshina Ye. V., Levitskaya L. A. and others. The Problem of the Change in the Peripheral Blood Under the Influence of Electric Sleep. In the book: "The Institute of Physiology. Theses." Moscow, 1954, page 62.
116. Shinder M. S., Gavrilova Ye. A. The Effect of the Type of Weather on Patients with Hypertensive Disease. Klinicheskaya meditsina [Clinical Medicine], 1953, Vol 31, No 10, pages 28-30.
117. Shcherbak A. Ye. Experimental Investigation of Iodine Iontophoresis. Publication of the Institute of Physical Methods of Treatment imeni Sechenov. Sevastopol', 1937, Vol 1, page 587.

118. Yakovlev I. I. and Petrov V. A. The Use of Electricity for Analgesia and Anesthesia. Publication of the TsNIAGI [Central Scientific Research Institute of Obstetrics and Gynecology], Leningrad, 1938.
119. Alexander L. Nonconvulsive Electric Stimulation Therapy. Amer. Journ. Psychiatry, 1950, 107, 4, 2411.
120. Arian E. Il Sonno curativo indotto da deboli impulsi galvanici a bassa frequenza (electro-sonno). Premesse fisiologiche. Minerva medica, 1956, 11, 82, 1083-1086.
121. Bowman K. and Simon A. Studies in Electronarcosis Therapy. I. Clinical Evaluation. Amer. Journ. Psychiatry, 1948, 105, 1, 15.
122. Frostig J., Harreveld A., Reznick S., Tyler D. and Wiersma C. Electronarcosis in Animal and in Man. Arch. Neurology and Psychiatry, 1944, 51, 232.
123. Giliarowski W. A., Liwenzew N. M., Segal J. u. E., Kirillova Z. A. Elektroshlaf. V. E. B. Verlag Volk und Gesundheit Berlin, 1956.
124. Harreveld A. On the Mechanism and Localization of the Symptoms of Electroshock and Electronarcosis. Journ. Neuropat. a Exp. Neurology, 1947, 6, 2, 177.
125. Van-Harreveld und Kok. "Über Elektronarcosis. Acta Brevia Neerlandica, 1933, 3, 45.
126. Hess W. The Mechanism of Sleep. Amer. Journ. Physiology, 1929, 90, 2, 386.
127. Ivy A. and Barry F. Studies on the Electrical Stunning of Dogs. Amer. Journ. Physiology, 1932, 99, 2, 298.
128. Koch H and Sack G. Elektronarkoseversuche. Untersuchung über die Wirkung periodischer rechtwinkliger Gleichstromstöße. Ztschr. f. d. ges. experim. Medizin, 1933, 90, 3-4, 365.
129. Leclerc G. L'anesthesie electrique chez l'homme. Assoc. franc. de chirurgie, Paris, 1910, 23, 665.
130. Leduc S. L'Inhibition cerebrale electrique chez l'homme. Arch. d'electricite medical, 1902, 120, 132.

131. Leduc S. Production du sommeil et de l'anesthésie générale par les courants électriques. Compt. rendus des seances de l'academie des sciences, 1902, 135, 878.
132. Leduc S. L'électrisation cérébrale. Arch. d'électricité médicale, 1903, 127, 521.
133. Leduc S. Production du sommeil et de l'anesthésie générale et locale par les courants électriques. Compt. rendus des seances de l'academie des sciences, 1902, 135, 199.
134. Nägelschmidt A. Über einem neuen dosierbaren Wechselstrom (Elektrischer Schlaf), Berlin, Klin. Wschr., 1912, 39, 1849.
135. Neergard K. Experimentelle Untersuchungen zur Elektornarkose. Arch. für klinische Chirurgie, 1923, 122, 100.
136. Pacella B. Electronarcosis in Psychiatric Therapy. New York State Journal of Medicine, 1948, 48, 21, 2387.
137. Paterson A. and Milligen W. Electronarcosis. A New Treatment of Schizophrenia. Lancet, 1947, 6467, 198.
138. Robinovitch L. Sommeil electric., Paris, 1906.
139. Robinovitch L. Electric Anesthesia. Its Use in Laboratory Work. Journal of Mental Pathology, 1909-1910, 8, 138.
140. Robinovitch L. Electric Anesthesia in Laboratory Surgery. Journal of Mental Pathology, 1909-1910, 8, 169.
141. Ross P. and Allen R. Electronarcosis. Anesthesiology, 1943, 4, 6, 42.
142. Sack G. u. Koch H. Zur Frage der sogenannten Elektornarkose durch wiederholte Gleichstromstosse. Ztschr. f. d. g. exper. Med., 1933, 90, 3-4, 349.
143. Samssonow N. Beitrag zum Studium der Elektronarkose. Pflug. Arch. f. d. g. Phys., 1933, 232, 4, 554.
144. Scheminzky F. Versuche über Elektrotaxis und Elektornarkose. Pflug. Arch. f. d. g. Phys., 1924, 202, 2, 200.

145. Scheminzky F. Zur Physiologie der Galvanonarkose bei Wassertieren. Pflug. Arch. f. d. g. Phys., 1936, 237, 3, 273.
146. Scheminzky F., Hochstadt O. and Adler P. Über das Wesen, der Galvanonarkose beim Frosch. Pflug. Arch. f. d. g. Phys., 1936, 237, 3, 284.
147. Tietz E., Thompson G., Harreveld A. and Wiersma C. Electronarcosis, its Application and Therapeutic Effect in Schizophrenia. Journ. Nervous. a. Mental. Disease, 1946, 103, 2, 144.
148. Zimmermann J. Untersuchung über die Anwendbarkeit der elektrischen Betaubung nach Leduc bei chirurgischen Eingriffen an Hunden. Munch. Tierärztliche Wschr., 1929, 80, 121, 141, 155.
149. Zimmern A. and Dimier G. Production experimentale de l'épilepsie et particulièrement du coma épileptique par les courants de Leduc. Arch. d'électricité medical, 1903, 127, 563.

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